

# 2020 VCE Biology examination report

## General comments

In 2020 the Victorian Curriculum and Assessment Authority produced an examination based on the adjusted 'Biology Study Design for 2020 only'. The examination provided students with the opportunity to demonstrate and apply a range of knowledge and skills.

This year, there was an extremely low number of questions not attempted by students. The paper gave guidance to and space for students to respond. It is important that students use the reading time to analyse each question, relate to experiences gained during the year and formulate answers to address each question's requirements.

Section B requires students to complete their answers in pen and write within the marked boundaries for each page so that the best image of the paper is obtained when it is scanned. Students can use pencil for questions that require a diagram or labelling, such as Question 2a. When a question asks for a name, such as in Questions 1bi., 4ai. or 7a., that is all that is required. However, when an explanation or description is required, students should provide information that is not given in the stem of the question.

Questions with three or more marks allocated generally require students to develop a considered response and articulate their answer. Students should use the information in the question, the marks available and the space provided when formulating their response.

## 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

| Question | % A | % B | % C | % D | Comments   |
|----------|-----|-----|-----|-----|--|
| 1        | 2   | 91  | 5   | 1   |  |
| 2        | 10  | 10  | 74  | 6   |  |
| 3        | 7   | 73  | 15  | 5   |  |
| 4        | 6   | 25  | 59  | 10  |  |
| 5        | 10  | 7   | 40  | 42  | Pathway 1 involves the breakdown of pyruvate, which does not generate ATP. ATP is generated when the glucose is broken down into pyruvate. Pathway 2 involves the Krebs cycle where NAD is loaded to form NADH and carries electrons to the electron transport chain.  |
| 6        | 15  | 57  | 20  | 8   |  |
| 7        | 22  | 33  | 4   | 41  |  |
| 8        | 17  | 2   | 70  | 11  |  |
| 9        | 4   | 85  | 2   | 9   |  |
| 10       | 83  | 1   | 1   | 14  |  |
| 11       | 55  | 21  | 14  | 10  | Both A and C were accepted as correct. Reliability is the degree of consistency, or repeatability, of a measure. Repeating the experiment may generate a larger pool of clustered results/measurements. Precision is a measure of how close repeated measurements are to each other. Repeating the experiment may result in increased precision if the repeated measurements are close together. Accuracy refers to how close a measurement is to a known or expected value. Repeating an experiment may not make the data more accurate. Validity refers to whether or not the experimental design allows the experimenter to measure what is supposed to be measured. The method of the experiment would need to be investigated for validity to be checked. |
| 12       | 8   | 8   | 76  | 8   |  |
| 13       | 1   | 1   | 3   | 95  |  |
| 14       | 4   | 86  | 7   | 3   |  |
| 15       | 5   | 1   | 5   | 88  |  |
| 16       | 6   | 82  | 5   | 6   |  |
| 17       | 11  | 81  | 1   | 7   |  |
| 18       | 65  | 15  | 6   | 14  |  |
| 19       | 9   | 71  | 18  | 1   |  |

| Question | % A | % B | % C | % D | Comments  |
|----------|-----|-----|-----|-----|---|
| 20       | 69  | 12  | 2   | 17  |   |
| 21       | 4   | 2   | 85  | 10  |   |
| 22       | 84  | 3   | 5   | 7   |   |
| 23       | 73  | 14  | 1   | 12  |   |
| 24       | 4   | 91  | 2   | 3   |   |
| 25       | 1   | 0   | 20  | 79  |   |
| 26       | 18  | 9   | 5   | 68  |   |
| 27       | 11  | 12  | 75  | 2   |   |
| 28       | 13  | 3   | 74  | 10  |   |
| 29       | 10  | 7   | 79  | 3   |   |
| 30       | 5   | 7   | 75  | 2   |   |
| 31       | 5   | 10  | 14  | 70  |   |
| 32       | 6   | 4   | 113 | 77  |   |
| 33       | 9   | 2   | 12  | 77  |   |
| 34       | 23  | 24  | 49  | 4   | The information states that vCJD in humans could be caused by eating infected cattle meat. Controlling the risk of an outbreak could therefore include preventing the consumption of infected cattle meat in some way. Yellow fever is stated to be a virus and carried by a mosquito vector. Reducing the number of mosquitoes or chances of being bitten by mosquitoes would assist in controlling the outbreak. Therefore, the combination of approaches that would be the most effective is Option C. |
| 35       | 5   | 67  | 13  | 15  |   |
| 36       | 3   | 1   | 5   | 91  |   |
| 37       | 1   | 90  | 3   | 6   |   |
| 38       | 6   | 9   | 71  | 14  |   |
| 39       | 62  | 5   | 25  | 9   |   |
| 40       | 68  | 8   | 23  | 1   |   |

## Section B

### Question 1a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 30 | 31 | 39 | 1.1     |

| Label | Specific function in the adrenaline-secreting cell                        |
|-------|---|
| GA    | To modify the protein into adrenalin or package adrenaline into vesicles. |
| M     | To provide energy for synthesis of adrenaline, for example.               |

Students were required to answer this question with specific reference to the adrenaline-secreting cell. An unacceptable answer would be 'to provide energy for the cell' and 'transport of proteins'.

### Question 1bi.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 21 | 79 | 0.8     |

Exocytosis

### Question 1bii.

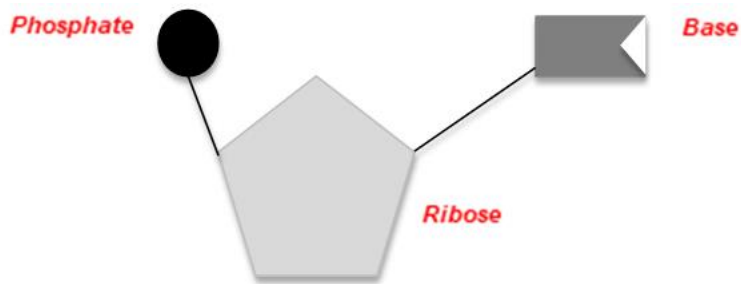
| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 34 | 20 | 46 | 1.1     |

Secretory (granules) (SG)/vesicles (V) containing the adrenaline fuse with the plasma membrane (PM) and release their contents.

Mitochondria (M) providing energy for this process was also an acceptable answer.

Question 1b. was answered well. In 1bii. a number of students wrote very long and detailed descriptions of the complete process of synthesis and concluded with the correct answer. While the description of synthesis was irrelevant, but not incorrect, marks were only awarded for the correct answer. Students are advised to not use valuable time providing irrelevant information in their responses.

## Question 2a.



| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 65 | 35 | 0.4     |

All three parts correctly labelled.

Some students named all the parts but did not have the labels in the correct position. Common incorrect answers for 'Ribose' were 'sugar', 'pentose' or '5 carbon'. These answers did not distinguish Ribose from Deoxyribose.

## Question 2b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 41 | 29 | 30 | 0.9     |

| Type of RNA | Specific role or function in the cell  |
|-------------|--|
| tRNA        | Brings an amino acid to the ribosome.<br>OR<br>Complementary anticodon binds with codon of mRNA.   |
| mRNA        | Carries genetic information from nucleus to the ribosomes.<br>OR<br>Complementary copy of the DNA. |

## Question 2c.

| Marks | 0  | 1 | 2  | 3  | 4  | Average |
|-------|----|---|----|----|----|---------|
| %     | 39 | 5 | 15 | 13 | 29 | 1.9     |

Any two of:

- Introns are removed, which are non-coding sequences.
- Exons are spliced together; they provide the code for protein synthesis.
- Poly A tail added, which facilitates export of final mRNA from nucleus or protects mRNA from degradation.
- Methyl/Guanine cap added, which protects mRNA from degradation or helps attach mRNA to the ribosome.
- Exons may be rearranged/changed during splicing before mRNA leaves the nucleus, increasing the variety of proteins and thus reactions that can occur in cells.

Many incorrect responses named and described transcription and translation as the two events.

## Question 3a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 53 | 18 | 28 | 0.7     |

Any two of:

- Photosynthesis is regulated by enzymes.
- Enzymes have an optimum temperature.
- Enzymes may denature at high temperatures or activity is decreased at lower temperatures.
- The greater the rate of reaction the more growth will occur.

Many students were unable to make the link that enzymes were involved in photosynthesis and therefore the importance of temperature.

## Question 3b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 25 | 27 | 48 | 1.2     |

Any two of:

- Green plants reflect green light OR do not use it for photosynthesis.
- Red light is used in photosynthesis OR increased availability of light for photosynthesis.
- More glucose is produced due to greater rate of photosynthesis.

### Question 3c.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 22 | 21 | 57 | 1.3     |

Any two of:

- Chloroplasts have their own circular DNA like the DNA found in bacteria.
- Chloroplasts have their own ribosomes.
- New chloroplasts are made by existing chloroplasts dividing in a similar way to how bacterial cells reproduce.
- Chloroplasts have a double membrane, one eukaryotic and one prokaryotic.
- They have a similar size and appearance.

### Question 4ai.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 19 | 28 | 53 | 1.3     |

Structure X: receptor

Structure Y: nuclear membrane

### Question 4aii.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 46 | 54 | 0.5     |

Examples of a possible process included:

- regulate gene expression
- breakdown of molecules/apoptosis
- activate a metabolic pathway
- synthesis of new molecules
- catalyse a reaction
- exocytosis.

## Question 4b.

| Marks | 0  | 1  | 2  | 3  | Average |
|-------|----|----|----|----|---------|
| %     | 24 | 15 | 30 | 31 | 1.7     |

| Step number | Step name    | Description of events occurring within this step   |
|-------------|--------------|--|
| 1           | Reception    | A ligand/protein/signalling molecule binds to a receptor.  |
| 2           | Transduction | Any one of: <ul style="list-style-type: none"><li>• A series of chemical reactions during which the signal is transferred.</li><li>• Signalling molecules generate a series of messengers that result in activation or deactivation of genes.</li><li>• The signal is amplified.</li></ul> |
| 3           | Response     | Any one of: <ul style="list-style-type: none"><li>• A protein is produced.</li><li>• A transcript is produced (or stopped), which causes a change in cell function.</li></ul>  |

Steps were required to be in the correct order for marks to be awarded. No consequential marks were awarded.

## Question 4c.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 30 | 23 | 47 | 1.2     |

The molecule is hydrophilic as it does not pass through the plasma membrane and it attaches to a receptor on the membrane.

Some students incorrectly referred to the molecule as being non-polar.

## Question 5a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 20 | 12 | 68 | 1.5     |

Correct responses included:

- Cytotoxic T cells or Memory Cytotoxic T cells:
  - The cell releases chemicals that break down or induce apoptosis in the viral infected cell.

OR

- Phagocyte or specific phagocyte (e.g. Dendritic cell, neutrophil, macrophage):
  - The cell engulfs and breaks down a viral infected cell.

Students were awarded marks if they correctly named the possible cell type as a Natural Killer Cell and provided a correct explanation.

T<sub>C</sub> cell for Cytotoxic T cell was accepted as this is a standard abbreviation for the cell type.



## Question 5bi.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 44 | 56 | 0.6     |

Suitable roles included any one of:

- storing memory cells or lymphocytes
- carrying antigens to the lymph nodes
- trapping antigens in the lymph nodes
- site of clonal selection
- transporting fluid containing lymphocytes, antibodies or immune cells
- site of clonal expansion.

## Question 5bii.

| Marks | 0  | 1 | 2 | 3  | 4  | Average |
|-------|----|---|---|----|----|---------|
| %     | 35 | 8 | 9 | 13 | 34 | 2.0     |

A suitable description of the sequence of events that occurs in the secondary lymphoid tissue included any four of the following:

- An antigen presenting cell presents the antigen.
- T helper cells are activated.
- The T helper cell activates a B cell.
- The B cell undergoes clonal expansion.
- Plasma cells are produced.
- The plasma cells produce antibodies.

Students were not required to name the specific secondary lymphoid tissue as part of their response. Standard abbreviations for cell types were accepted (e.g. T<sub>h</sub> cell for T helper cell).

Students were able to provide an explanation of clonal expansion without writing the specific term.

Students who demonstrated a detailed understanding of the sequence of events wrote accurate answers of varying lengths.

## Question 6a.

| Marks | 0 | 1  | 2  | Average |
|-------|---|----|----|---------|
| %     | 6 | 25 | 69 | 1.6     |

Any two of:

- constant and reliable supply
- purer or more effective product
- larger quantities
- less chance of side effects such as allergies
- more appealing to patient rather than using animals.

This part was well answered by students.

## Question 6b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 28 | 32 | 40 | 1.1     |

Some suitable examples of an ethical issue are:

- Who has the legal ownership and how is will the product be made available for all people in the world?
- Changing a species' DNA may result in unforeseen consequences.
- Concern that the pharmaceutical product may contain bacteria that will cause disease.
- Not natural and therefore may be against religious/moral views.

Some students correctly identified a concern relating to gene cloning but failed to give an ethical justification.

## Question 7a.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 27 | 73 | 0.7     |

An accepted type of mutation is any one of

- substitution
- point
- missense.

Some students correctly wrote a combination of the above responses, although only one was required. Students are encouraged to write only one response when directed to avoid possible contradictory responses.

## Question 7bi.

| Marks | 0  | 1  | 2  | 3  | Average |
|-------|----|----|----|----|---------|
| %     | 32 | 28 | 29 | 12 | 1.2     |

Suitable explanations for the increase in frequency of the allele are any three of:

- Individuals in populations where milk is part of their diet would be at a selective advantage.
- Individuals in populations without the mutation were selected against, leading to more individuals with the mutation in the population.
- Populations or individuals with the mutation produced more offspring than those without the mutation.
- Genetic drift occurred more quickly in smaller populations.
- Strong selection pressure for populations to maintain the lactase allele.

A suitable reference to the consumption of milk or ability to digest lactose was required for full marks to be awarded. This reference did not have to occur in the first point given above.

## Question 7bii.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 36 | 41 | 22 | 0.9     |

Suitable reasons for the absence of the mutation in the population are any two of:

- The population may not have a diet that relies on milk as a main source of energy. Individuals with the mutation are not at an advantage and the allele has disappeared.
- There was no gene flow between populations with and without the mutation.
- The population may have been established through the founder effect in which no individuals in the founding population had the mutation.

## Question 7c.

| Marks | 0  | 1 | 2  | Average |
|-------|----|---|----|---------|
| %     | 17 | 5 | 77 | 1.6     |

The farmers would select the cows that produce the most milk. These cows would be bred.

## Question 8a.

| Marks | 0  | 1  | 2  | 3  | Average |
|-------|----|----|----|----|---------|
| %     | 13 | 15 | 47 | 26 | 1.9     |

*Amatitlania siquia* and *Hypsophrys nematopus* share a more recent common ancestor and therefore have less time to accumulate differences in the DNA.

This question was well answered, with students applying their knowledge in the given situation and identifying the consequences.

## Question 8b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 22 | 38 | 40 | 1.2     |

Fossilisation is more likely in water, as there is:

- more sediment, so remains are covered quicker, which reduced decomposition or hid them from scavengers
- less disturbance, so remains are preserved
- less oxygen or lower temperatures, so reduced decomposition.

Students were also able to take the converse approach and explain why fossilisation on land is less likely.

## Question 8c.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 28 | 32 | 40 | 1.1     |

Radiocarbon dating is a technique in which scientists may have measured the ratio of carbon-14 to carbon-12 to determine the fossil's age.

Students were required to identify the technique (absolute dating) and give an outline of this. Many students successfully answered this question.

## Question 9a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 22 | 42 | 36 | 1.1     |

Accepted structural features include any two of:

- smaller brain case
- larger brow ridge
- more sloping forehead
- larger jaw
- less slender zygomatic arch.

## Question 9b.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 43 | 57 | 0.6     |

An accepted difference between Figures 1 and 2 is any one of:

- In Figure 1 *Homo ergaster* and *Homo sapiens* share a common ancestor but do not in Figure 2.
- In Figure 2 *Homo ergaster* is shown to be a direct ancestor of *Homo sapiens* but is not a direct ancestor in Figure 1.
- In Figure 1 *Homo ergaster* and *Homo sapiens* are more closely related with a more recent common ancestor than in Figure 2.

Some responses were too general and did not address the evolutionary relationships between the two species. Students should be clear regarding the difference between ancestors and descendants.

## Question 9c.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 62 | 22 | 16 | 0.5     |

The branch for *Homo denisovans* should appear either alongside *H. neanderthalensis*, in the same branch as *H. sapiens* and *H. neanderthalensis* or branching from *H. heidelbergensis*.

Depending on where the student has drawn the branch, any one of the following justifications is accepted:

- It is believed, or there is DNA evidence, that *Homo denisovans* interbred with *H. sapiens* and *H. neanderthalensis*.
- DNA evidence indicates *Homo denisovans* is most closely related to Neanderthals.
- DNA evidence suggests *H. heidelbergensis* is an ancestor of the *Homo denisovans*.

DNA evidence can include molecular homology and students could refer to similarities between proteins, amino acids or other relevant DNA evidence without using the term 'DNA evidence'.

The justification given must relate to the placement of the branch drawn.

Students found drawing the branch to represent where *Homo denisovans* should be placed to be challenging. Many students were unable to show an understanding of when *H. Denisovans* existed in relation to the Homo species shown in Figure 2 and their relationship to other Homo species.

## Question 9d.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 36 | 41 | 23 | 0.9     |

Accepted explanations for the position of the Homo species are any two of:

- There are gaps in the fossil record.
- As new discoveries of fossils are made, this can alter previous views or ideas held by scientists.
- Some fossils are incomplete or only very small fragments are found.

## Question 10a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 13 | 17 | 70 | 1.6     |

The outbreak is best described as an epidemic as it is contained within the region of Samoa and did not spread globally over multiple countries or continents.

## Question 10b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 24 | 22 | 54 | 1.3     |

The age of the students less likely to die from measles was under six months old.

An acceptable reason is any one of:

- These children are protected by passive natural immunity/antibodies from their mother's breast milk or placenta.
- After six months of age, breastfeeding is reduced so passively acquired antibodies may no longer be circulating.
- Children under six months old may be less likely to come into contact with as many people as older children.

Some students correctly explained point three above in terms of reduced mobility of children under six months old.

## Question 10ci.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 16 | 84 | 0.8     |

64 per cent

Students were not awarded marks if they only stated the vaccination rates for vaccinated children in Samoa and Australia.

## Question 10cii.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 38 | 62 | 0.6     |

The type of immunity is artificial and active.

## Question 10ciii.

| Marks | 0 | 1  | 2  | Average |
|-------|---|----|----|---------|
| %     | 6 | 38 | 56 | 1.5     |

Any two of:

- Herd immunity occurs.
- High vaccination rates reduce the number of susceptible hosts.
- High vaccination rates reduce the chance of the virus spreading.

## Question 10d.

| Marks | 0 | 1  | 2  | Average |
|-------|---|----|----|---------|
| %     | 5 | 18 | 77 | 1.7     |

Any two of:

- wearing protective equipment (e.g. masks, gloves, eye protection)
- quarantine or isolation of affected individuals
- washing hands or using hand sanitiser
- limiting gatherings to small numbers of individuals
- wiping surfaces with disinfectant.

Students were able to provide a variety of accepted responses in addition to those described above.

As the question asks the students to 'describe', some description was required.

## Question 11a.

| Marks | 0  | 1  | 2 | 3  | 4 | 5  | Average |
|-------|----|----|---|----|---|----|---------|
| %     | 28 | 11 | 9 | 17 | 9 | 26 | 2.5     |

Any five of:

- Shorter fragments move further and longer fragments move lesser.
- Standard used as a comparison and reference.
- **BamH1** cuts the DNA fragment in one place and produces **two** fragments.
- **HindIII** cuts the DNA fragment in two places and produces **three** fragments.
- Largest/smallest fragments are produced when cut by **HindIII**
- **BamH1** fragment length are **4000bp** and **5500bp** and **HindIII** fragment length are **8000bp, 1000bp** and **500bp**.
- When the two endonucleases are present, **four** fragments are produced, sizes of **5500bp, 2500bp, 1000bp** and **500bp** are produced.

This question provided students with the opportunity to apply the information provided to the gel and then analyse the results provided.

## Question 11b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 28 | 52 | 20 | 0.9     |

Any one of:

- Absence of bands for **BamH1/Tube 1** may have been caused by incorrect loading of the DNA sample into the well.
- Only one band for **HindIII/Tube 2** may have been caused by restriction enzyme being denatured.

## Question 11c.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 14 | 54 | 32 | 1.2     |

Two factors are:

- size or length of the fragments
- concentration or viscosity of the agarose
- voltage or power used.

The length of time was not a suitable response.

## Question 11d.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 15 | 49 | 37 | 1.2     |

Some examples of suitable answers are:

- Making sure the electrophoresis equipment is turned off to avoid electrocution.
- Wearing safety glasses to protect the eye.
- Wearing gloves to avoid contamination by DNA or the chemicals being used.
- Correct disposal of materials.

This was well answered and demonstrated that students could apply their knowledge from practical work in this situation.