Neap

Trial Examination 2020

# VCE Biology Unit 3

## Written Examination

## Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

**Structure of booklet**

| *Section* | *Number of questions* | *Number of questions to be answered* | *Number of marks* |
|---|---|---|---|
| A | 25 | 25 | 25 |
| B | 7 | 7 | 50 |
| | | | Total 75 |

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

No calculator is allowed in this examination.

**Materials supplied**

Question and answer booklet of 20 pages.

Answer sheet for multiple-choice questions.

**Instructions**

Please ensure that you write **your name** and your **teacher's name** in the space provided on this booklet and in the space provided on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

**At the end of the examination**

Place the answer sheet for multiple-choice questions inside the front cover of this booklet.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

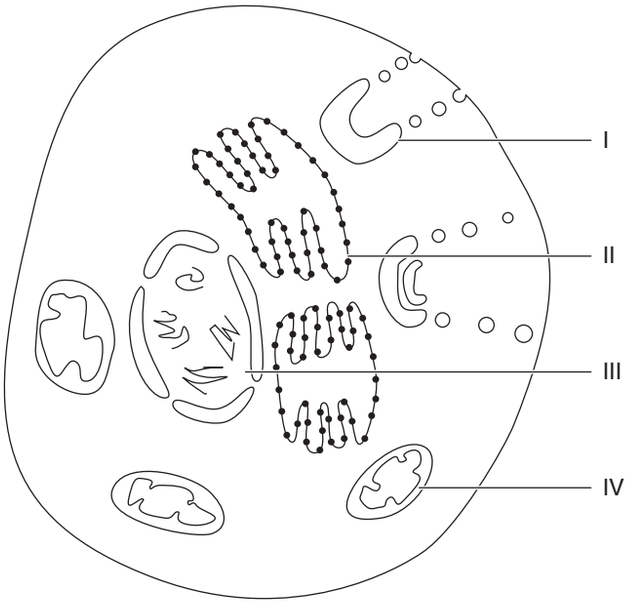
Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2020 VCE Biology Units 3&4 Written Examination.

## SECTION A – MULTIPLE-CHOICE QUESTIONS

**Instructions for Section A**

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1; an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.
Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

*Use the following information to answer Questions 1 and 2.*




**Question 1**

The type of molecule being secreted from the cell shown above is

**A.** a lipid.

**B.** hydrophobic.

**C.** a protein.

**D.** a nucleic acid.

**Question 2**

Which row in the following table gives the correct names and functions of the organelles labelled I–IV in the diagram above?

| | Name of organelle | Function of organelle |
|---|---|---|
| **A.** | vesicle | protein synthesis |
| **B.** | endoplasmic reticulum | intercellular transport |
| **C.** | nucleolus | control centre of the cell |
| **D.** | mitochondria | site of the electron transport chain |

*Use the following information to answer Questions 3 and 4.*

Beetroot cells are excellent for modelling the factors that affect membrane structure and function because they contain a red pigment called betalain. Betalain is released from beetroot cells if there is membrane damage.

Four students conducted an experiment using beetroot. Each student washed several 1 $cm^3$ cubes of fresh beetroot to remove any external pigment, but retain cellular pigment. Each cube was placed into 10 mL of distilled water and then exposed to a different temperature for each cube. After 20 minutes, the colour of each solution was measured with a colourimeter to determine how transparent the solutions were. Each temperature was measured four times by each student and the results were averaged.

The results of the experiment are shown in the table below.

| **Temperature (°C)** | **Average transparency (%)** |
|---|---|
| 2 | 25 |
| 10 | 52 |
| 20 | 97 |
| 30 | 100 |
| 40 | 76 |
| 45 | 13 |

**Question 3**

It would be appropriate to state that

**A.** the experiment had no reproducibility but much repeatability.

**B.** the precision of the obtained data was high.

**C.** a controlled variable was the average transparency of the solutions.

**D.** the experiment was valid because temperature was the only factor being varied.

**Question 4**

A suitable explanation of the results is that

**A.** the 25% transparency at 2°C illustrates minimal damage to the beetroot membrane.

**B.** at 45°C, the proteins within the beetroot membrane are denatured, leaving 'holes' in the membrane and allowing betalain to move into the solution.

**C.** the beetroot membrane is non-functional at 30°C because the transparency is 100%.

**D.** cholesterol has moved further into the beetroot membrane at 10°C allowing more fluidity in the cooler environment.

**Question 5**

A condensation reaction includes

**A.** the conversion of a polypeptide into dipeptides by protease.

**B.** the combination of two different amino acids at a ribosome.

**C.** the combination of two polypeptide chains into a quaternary arrangement via a disulphide bridge.

**D.** glucose forming pyruvic acid during glycolysis.

**Question 6**

The DNA template strand below contains two DNA triplets:

GAC TAC

The anticodons formed from these triplets during protein synthesis are

**A.** GAC TAC.

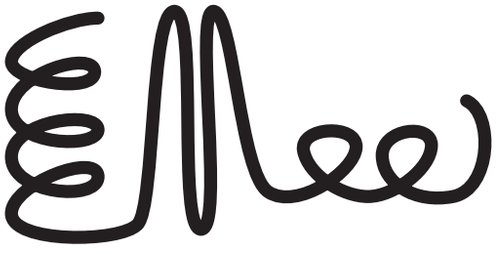
**B.** CTG ATG.

**C.** GAC UAC.

**D.** CUG AUG.

**Question 7**

A polypeptide has the structure shown below, which represents 50 amino acids.



Which one of the following statements about the polypeptide shown above is correct?

**A.** If the DNA template coding for the polypeptide was from a eukaryotic cell, it would be 153 nucleotides long.

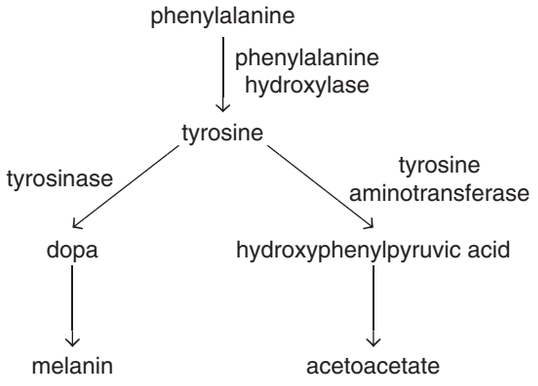
**B.** The primary sequence for this polypeptide would be the same for each mRNA strand coding for the same polypeptide.

**C.** The $\beta$-helices and $\alpha$-sheets make up the secondary structure of this polypeptide.

**D.** Post-transcriptionally, exons would be spliced out and introns would be joined together prior to the translation.

*Use the following information to answer Questions 8 and 9.*

Every child born in Australia has the opportunity to be tested for phenylketonuria (PKU), a genetic disorder. If diagnosed early, appropriate medical intervention can be undertaken. People with PKU lack the enzyme phenylalanine hydroxylase, which is part of the metabolic pathway shown below.




**Question 8**

The cellular conditions that would enable optimal functioning of tyrosine aminotransferase in a human who does **not** have PKU would be

**A.** a high concentration of dopa.

**B.** body temperature and a pH of 9.

**C.** room temperature and a pH of 7.

**D.** body temperature and a pH of 7.

**Question 9**

Based on the information provided above, sufferers of PKU would experience

**A.** a build-up of tyrosine.

**B.** a low level of tyrosinase.

**C.** a high level of phenylalanine.

**D.** an accumulation of the product of the reaction catalysed by phenylalanine hydroxylase.

**Question 10**

A reaction that occurs in the mitochondrial matrix and has inputs of pyruvic acid, ADP and NAD is

**A.** glycolysis.

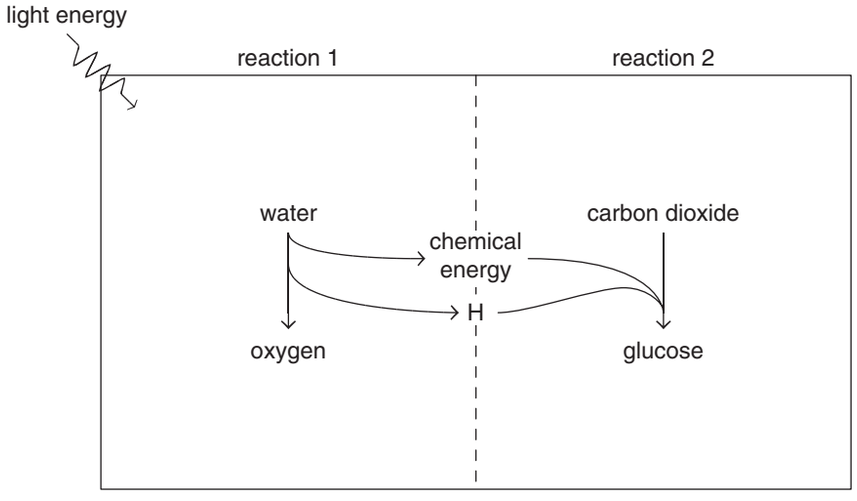
**B.** ethanol fermentation.

**C.** the Krebs cycle.

**D.** the electron transport chain.

*Use the following information to answer Questions 11–13.*

The diagram below represents a chemical reaction occurring inside a cell of a multicellular organism. Reaction 1 and reaction 2 are both important for the overall reaction.




**Question 11**

Where are the locations of reaction 1 and of reaction 2?

| | Reaction 1 | Reaction 2 |
|---|---|---|
| **A.** | stroma | grana |
| **B.** | cytosol | stroma |
| **C.** | nucleoplasm | cytosol |
| **D.** | grana | stroma |

**Question 12**

The coenzymes that move from reaction 1 to reaction 2 are

**A.** ADP and NADPH.

**B.** ATP and NADPH.

**C.** ATP and NADP.

**D.** ADP and NADH.

**Question 13**

A continuous increase in light energy, starting from no light, would

**A.** lead to a linear increase in glucose concentration.

**B.** lead to a plateau in glucose concentration.

**C.** not change the photosynthetic rate.

**D.** lead to a linear increase in carbon dioxide absorption into the multicellular organism.

**Question 14**

A signalling molecule that travels through the bloodstream to bind to an intracellular receptor within a target cell are called

**A.** pheromones.

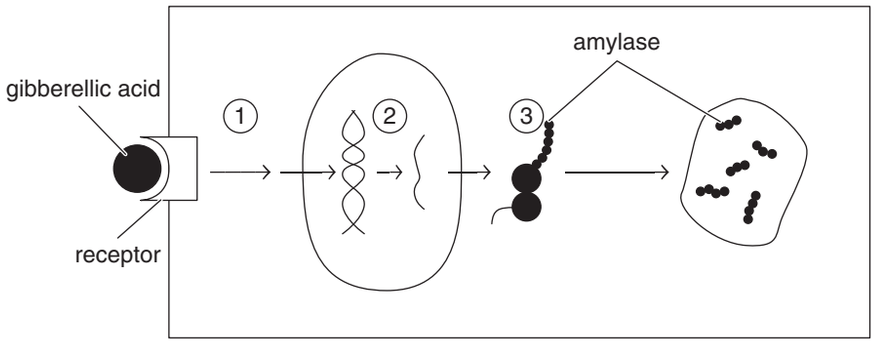
**B.** neurotransmitters.

**C.** hydrophilic hormones.

**D.** hydrophobic hormones.

*Use the following information to answer Questions 15 and 16.*

The diagram shown below demonstrates the action of gibberellic acid in an aleurone cell within a germinating seed. The amylase is secreted from the cell, which acts in the endosperm of the seed by converting starch into simple sugars.




**Question 15**

Which one of the following is the most appropriate description of the receptor?

**A.** The receptor has the same shape as the gibberellic acid.

**B.** Molecules other than gibberellic acid could bind to the receptor, stimulating the same response.

**C.** The receptor has a complementary shape to the gibberellic acid.

**D.** When functional, the receptor is not always bound to the plasma membrane of the cells.

**Question 16**

Which row in the following table correctly states the names for the stages labelled as 1, 2 and 3 in the diagram above?

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| **A.** | transcription | signal transduction | translation |
| **B.** | signal transduction | translation | transcription |
| **C.** | translation | transcription | signal transduction |
| **D.** | signal transduction | transcription | translation |

**Question 17**

A single plant hormone, auxin, binds to a receptor on the shaded side of a growing plant, located 2 cm below the tip of its stem. Internally, a series of actions occurs as listed below:

1. The mobilised receptor activates five G protein complexes.
2. Each G protein activates a specific transcription factor.
3. The transcription factors bind to an operator section of a growth protein gene.
4. The growth protein gene is transcribed ten times, while the transcription factor is bound to the operator section of the growth protein gene.
5. Each mRNA strand moves through ten ribosomes to form ten growth proteins.

The most appropriate name for this phenomenon is

**A.** signal amplification.
**B.** signal transduction.
**C.** competitive inhibition.
**D.** negative feedback.

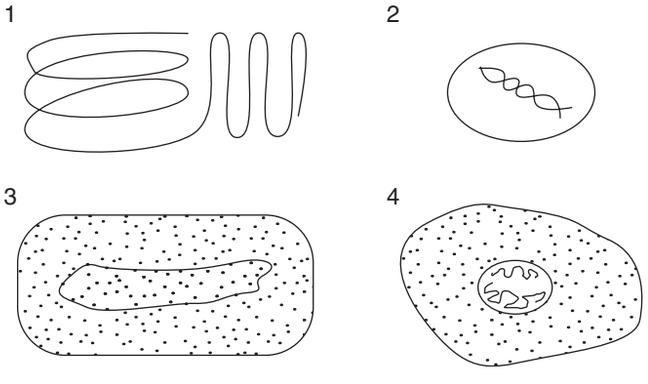
**Question 18**

If the rate of cell replacement is greater than the rate of apoptosis within a fully grown human, then

**A.** a disease such as cancer could develop.
**B.** an autoimmune condition such as multiple sclerosis (MS) could develop.
**C.** this could be due to an immunodeficiency disorder such as human immunodeficiency virus (HIV).
**D.** an allergy to pollen could have developed.

**Question 19**

The diagrams below illustrate either cellular or non-cellular pathogens.




Whichrow in the following table correctly describes one of the above pathogens?

| | Number | Cellular/Non-cellular | Classification | Example |
|---|---|---|---|---|
| **A.** | 1 | non-cellular | prokaryotic | prion |
| **B.** | 2 | cellular | prokaryotic | influenza |
| **C.** | 3 | non-cellular | eukaryotic | streptococcus |
| **D.** | 4 | cellular | eukaryotic | malarial plasmodium |

**Question 20**

Which one of the following is a chemical barrier possessed by a multicellular organism that keeps pathogens from entering the body?

**A.** the acidic environment of the stomach, which is detrimental to many bacterial pathogens such as salmonella

**B.** the waxy cuticle on the surface of a leaf, which prevents the growth of fungal spores

**C.** the presence of a thick epidermal layer on the surface of a rhinoceros, which prevents the tsetse fly (a vector carrying a trypanosome protozoan) from having a blood meal and transferring the pathogen to the rhinoceros

**D.** the very small stomata on the underside of a rhododendron leaf, which reduce the chance of a virus entering the substomatal space

**Question 21**

The action of inflammation when the body is under pathogenic attack can be beneficial because

**A.** capillary beds become less porous, thus restricting the exit of pathogens from the infected area.

**B.** a reduced population of macrophages are attracted to the area so that the symptoms of the infection are more evenly spread throughout the body.

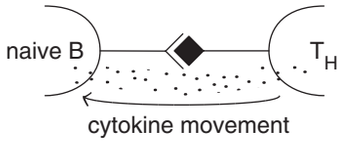
**C.** the lymphatic ducts restrict the uptake fragments of the pathogen.

**D.** more heat in the infected area is detrimental to the survival of the pathogen.

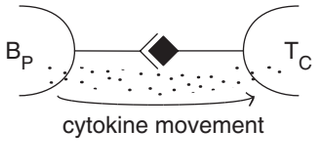
**Question 22**

Which one of the following situations correctly represents the action of cytokines?

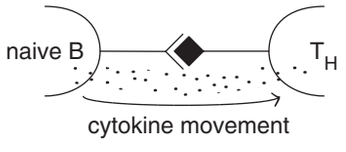
**A.**



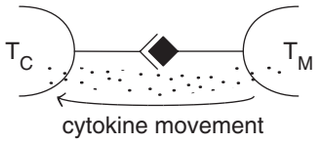

**B.**




**C.**

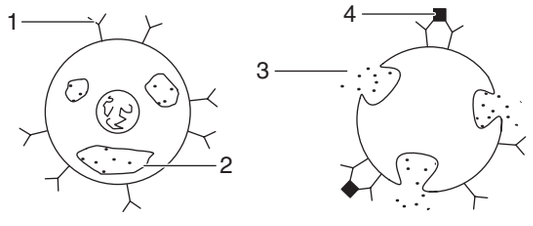



**D.**




**Question 23**

The diagram below illustrates the action of a mast cell when exposed to an allergen.




Which row in the following table gives the correct terms for the structures labelled 1–4?

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **A.** | antigen | vesicle | antibody | substrate |
| **B.** | allergen | mitochondria | histamine | antigen |
| **C.** | antibody | nucleus | neurotransmitter | allergen |
| **D.** | antibody | vesicle | histamine | allergen |

**Question 24**

A monoclonal antibody called alemtuzumab is manufactured to treat some patients with chronic lymphocytic leukemia (CLL). Alemtuzumab binds to the CD52 antigen, which is found on lymphocytes (which include leukemia cells). Once attached, alemtuzumab attracts other immune cells to destroy these lymphocytes.

This a form of

**A.** artificial passive immunity.

**B.** natural passive immunity.

**C.** artificial active immunity.

**D.** natural active immunity.

**Question 25**

Up to 10% of many European populations are resistant to developing acquired immunodeficiency syndrome (AIDS). Many people within these populations have come into contact with HIV. Routine blood tests indicate they are HIV positive (that is, antibodies against HIV are present in the bloodstream). However, these individuals do not develop any AIDS-like symptoms. This is due to a CD4 receptor site on the surface of their T helper cells that is different to those in the rest of the population.

The best explanation for these AIDS-resistant individuals is that

**A.** the virus does not destroy T helper cells, thus enabling the humoral and cell-mediated responses to proceed normally.

**B.** the virus does not destroy B cells, thus enabling the humoral response to proceed normally.

**C.** the CD4 receptor site is blocked, enabling T helper cells to control the immune response.

**D.** the antibodies have been passed across the placenta into the individual, indicating that they have not ever come into contact with the virus.

**END OF SECTION A**

## SECTION B

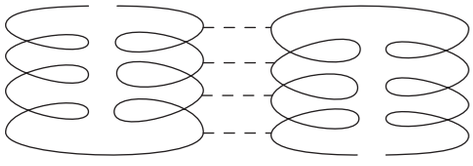
**Instructions for Section B**

Answer **all** questions in the spaces provided. Write using blue or black pen.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

**Question 1** (5 marks)

The diagram below shows a functional protein that is partially embedded (peripheral protein) in the inner side of the plasma membrane, allowing cytoskeletal proteins to bind to it.



**a.** Describe how the tertiary **and** quaternary level of protein structure contributes to this functional protein. You may refer to the above diagram. 2 marks

**b.** Describe the differences in the R groups of the amino acids that allow a peripheral protein such as the one shown in the above diagram to be both partially in contact with the cytosol and partially in contact with the membrane. Include a labelled diagram of the membrane in the space provided to support your answer. 3 marks

**Question 2** (8 marks)

Two biochemists were investigating the differences between gene expression in a prokaryotic cell and a eukaryotic cell. The table below shows the DNA template strand from the gene region of one of the cells.

| G | C | A | T | A | C | G | T | C | A | T | C | A | T | G |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | |

**a.** **i.** Complete the table above with the mRNA sequence that is complementary to the DNA template. 1 mark

**ii.** Describe the sequence of events that would occur during the translation of this mRNA sequence. 3 marks

**b.** State **two** differences in the process of gene expression that would indicate that the mRNA sequence above was from a prokaryotic cell rather than a eukaryotic cell. 2 marks

**c.** It was also noted that the mRNA sequence was part of the transcribed product of the *lac* operon.

**i.** Describe the function of the operator region of the *lac* operon. 1 mark

**ii.** Describe the function of the promoter region of the *lac* operon. 1 mark

**Question 3** (6 marks)
In the liver, alcohol dehydrogenase (ADH) converts ethanol into acetaldehyde.

**a.** In the space below, summarise the information above in a word equation. Include the substrate, product and enzyme in the equation. 1 mark

**b.** Explain how ADH carries out its function. 2 marks

**c.** One standard drink carries 10 g of ethanol, and it takes the liver about an hour for ADH to completely break down the ethanol. Through a simple chemical reaction, acetaldehyde can bind with a chemical called formazan that, depending on the concentration of acetaldehyde present, will vary in colour intensity. The colour intensity can be measured using arbitrary units (AU). The higher the concentration of acetaldehyde, the greater the colour intensity. The table below shows the results of a variety of tests relating to the activity of ADH. Each test was conducted over a one-hour period.

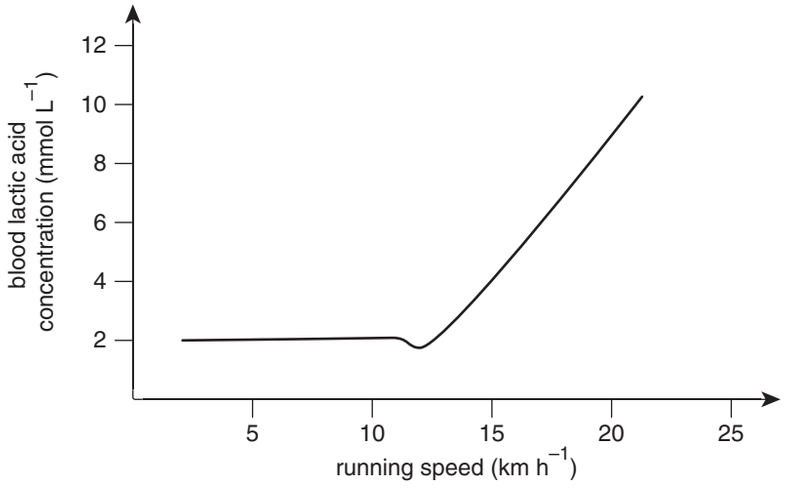
| Test | Conditions | Colour intensity (AU) |
|---|---|---|
| 1 | 10 g ethanol; 1 g ADH; 37°C; pH 6.8 | 70 |
| 2 | 50 g ethanol; 1 g ADH; 37°C; pH 6.8 | 70 |
| 3 | 50 g ethanol; 0.5 g ADH; 37°C; pH 6.8 | 30 |

Over time, some individuals can develop alcohol-damaged livers, which means fewer cells are functioning normally.

Using evidence from the table above, describe the effect on ADH function of alcohol-damaged livers. 3 marks

**Question 4** (8 marks)

Aerobic fitness is important for health and performance in a variety of physical pursuits. Robert was interested in improving his aerobic fitness. He went to a fitness clinic and performed a series of tests on a treadmill. At each tested speed, Robert had the lactic acid levels in his blood tested. The results of the testing are shown in the graph below.




**a.** **i.** Write a suitable hypothesis for this experiment. 1 mark

**ii.** What was Robert's lactic acid level at a running speed of 18 km h$^{-1}$? 1 mark

**b.** Describe the cellular events that occur when glucose is broken down by Robert's body anaerobically. In your answer state **two** inputs, **two** outputs **and** the cellular location of the process. 3 marks

**c.** Robert trained with different exercises to improve his speed and strength. After a month, he performed the same series of tests that were initially conducted at the fitness clinic.

Draw a line on the graph on the previous page that would demonstrate that Robert had improved his aerobic fitness. 1 mark

**d.** Fitness programs are an expensive means of improving fitness levels. It is important that customers wishing to join a fitness program are provided with scientifically supported information by the program.

State **two** reasons why Robert's test results would **not** be considered scientifically relevant. 2 marks

_____

_____

_____

_____

**Question 5** (8 marks)

Quinoa is a plant with great nutritional benefits that more people are seeking to eat in Australia. Quinoa has a tolerance to high temperatures, low water availability and high salinity, which makes it a viable food source to grow in Australia as climate change effects which crops grow best in that environment.

At high temperatures, an increased production of chaperone proteins occurs. Chaperone proteins help to retain the manufacture and shape of functional proteins within cells. This enables proteins to remain stable in warmer conditions.

**a.** **i.** Where in a cell are chaperone proteins synthesised? 1 mark

_____

**ii.** Using a specific example, show how the stability of proteins in a cell could be advantageous for survival in warmer conditions. 2 marks

_____

_____

_____

_____

**b.** When water availability is low, an increased production of osmolytes occurs in the cell, such as an increase in organic molecules like glucose.

**i.** Identify **one** benefit of water for a typical plant cell. 1 mark

_____

_____

**ii.** Describe how internal osmolytes help to maintain the water content of a cell. 1 mark

_____

_____

**c.** In high salinity, more of the plant hormone abscisic acid is secreted from cells, which binds to receptors on the surface of target cells. One of the actions of this hormone is to stimulate the movement of ions into cells.

**i.** Describe the chemical nature of abscisic acid. 1 mark

_____

_____

**ii.** Referring to signal transduction, show how abscisic acid binding to a receptor could lead to more ions being moved into a cell. 2 marks

_____

_____

_____

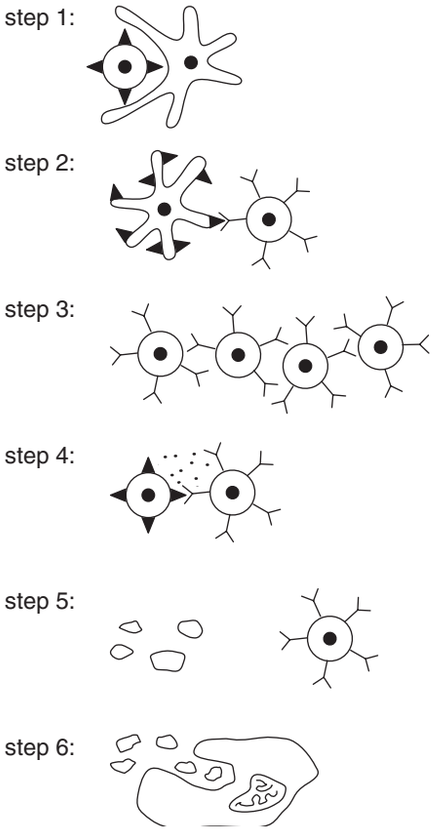
_____

**Question 6** (8 marks)

While walking in bare feet, Cameron stood on a prickle that had a pathogenic organism on it.

**a.** Describe how inflammation at the site of Cameron's injury would occur almost immediately. 2 marks

The following diagram shows the steps involved in an immune response where Cameron's body is exposed to the antigen on the surface of the foreign cell (pathogen). The pathogen was introduced into the muscle tissue of Cameron's toe via a prickle.




Complete the table below with the cells involved in the specific immune response steps, as well as the type of response (innate or active) and the location of the immune response step within the body. 6 marks

| Step | Cells involved | Type of response (active or innate) | Location of the immune response step within the body |
|---|---|---|---|
| 2 | | | |
| 4 | | | |
| 6 | | | |

**Question 7** (7 marks)

Over twelve million influenza vaccines were administered in Australia during the 2018–19 influenza season. However, a record number of 217 000 people were diagnosed with influenza during that time period. In late September 2019, the official national death toll due to influenza was 430.

**a.** **i.** Outline the contents of a vaccine used to prevent an influenza strain. 1 mark

**ii.** Describe the body's initial immune response against such a vaccine. 3 marks

**b.** In a class discussion, Vicki suggested that a humoral response was a more likely long-term immune response against the influenza vaccine, but Hayley said it was more likely to initially be a cell-mediated response. Karla disagreed and said it was most likely to be a combination of both humoral and cell-mediated immunity.

Identify which **one** of the three students is correct. Justify your response. 3 marks

**END OF QUESTION AND ANSWER BOOKLET**

Neap

Trial Examination 2020

# VCE Biology Unit 3

## Written Examination

## Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

### Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out. Marks will **not** be deducted for incorrect answers.
**No** mark will be given if more than **one** answer is completed for any question.

All answers must be completed like this example: A B **C** D

## Use pencil only

| | | | | |
|---|---|---|---|---|
| 1 | A | B | C | D |
| 2 | A | B | C | D |
| 3 | A | B | C | D |
| 4 | A | B | C | D |
| 5 | A | B | C | D |
| 6 | A | B | C | D |
| 7 | A | B | C | D |
| 8 | A | B | C | D |
| 9 | A | B | C | D |
| 10 | A | B | C | D |
| 11 | A | B | C | D |
| 12 | A | B | C | D |

| | | | | |
|---|---|---|---|---|
| 13 | A | B | C | D |
| 14 | A | B | C | D |
| 15 | A | B | C | D |
| 16 | A | B | C | D |
| 17 | A | B | C | D |
| 18 | A | B | C | D |
| 19 | A | B | C | D |
| 20 | A | B | C | D |
| 21 | A | B | C | D |
| 22 | A | B | C | D |
| 23 | A | B | C | D |
| 24 | A | B | C | D |
| 25 | A | B | C | D |