Neap

Trial Examination 2022

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 19 pages

Answer sheet for multiple-choice questions

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, 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.

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.

Question 1

Three components that could make up DNA nucleotides are

A. ribose, phosphate and an uracil nitrogenous base.

B. deoxyribose, phosphorous and an adenine nitrogenous base.

C. ribose, phosphorous and a cytosine nitrogenous base.

D. deoxyribose, phosphate and a thymine nitrogenous base.

Question 2

Redundancy in the DNA code means that

A. the amino acid valine has four possible codons.

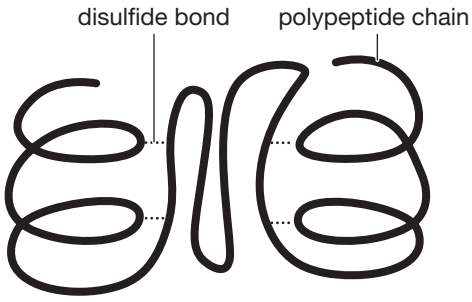
B. the amino acids methionine and isoleucine are both coded for by AUG.

C. uracil replaces thymine in the translated nucleic acid.

D. each tRNA molecule can carry any amino acid.

Question 3

The following diagram represents a polypeptide chain that functions as a catalyst in the cytosol of a human cell.



It is reasonable to state that

A. each catalyst that is expressed in a cell would be coded for by the same nucleotide sequence.

B. this catalyst is functional at the quaternary level of arrangement.

C. β-helices and α-pleated sheets make up a significant part of the secondary level of the arrangement.

D. the disulphide bonds would be prone to breaking if the cell is exposed to an environmental temperature exceeding 42°C.

Question 4

The term 'genomics' was first coined in 1986 and was primarily used to describe the study of the structure and function of DNA within eukaryotic cells. Genomics led to the development of other branches of science and, in 1997, proteomics emerged. Proteomics involves the study of the structure and function of proteins within eukaryotic cells.

Which one of the following statements gives a clear difference between the genome and the proteome?

A. The genome within each cell of a multicellular organism is the same but the proteome is different.

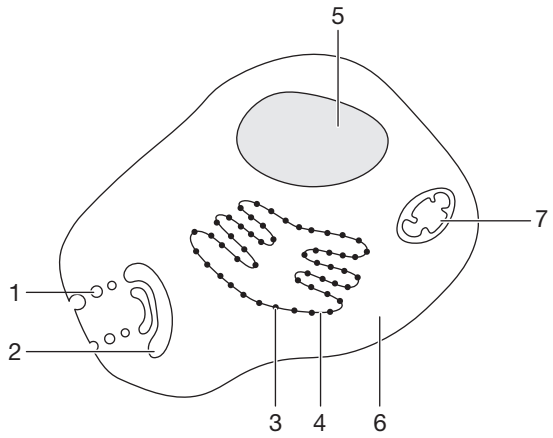
B. The genome within each cell of a multicellular organism is different but the proteome is the same.

C. Within a multicellular organism, the genome is found exclusively in the nucleus and the proteome is found exclusively in the cytosol.

D. Within a multicellular organism, the genome provides a blueprint for protein and the proteome provides a blueprint for molecules other than protein.

Question 5

The following diagram shows a typical secretory cell, such as the β-cell that secretes the insulin protein and is found in the pancreas. The organelles labelled 1–7 in the diagram are the components of the cell that are involved in the synthesis, internal transport, modification, packaging and export of the substance being secreted from the cell.



In which order are the organelles directly involved in the synthesis, internal transport, modification, packaging and export of insulin?

A. 1, 2, 3, 4, 5

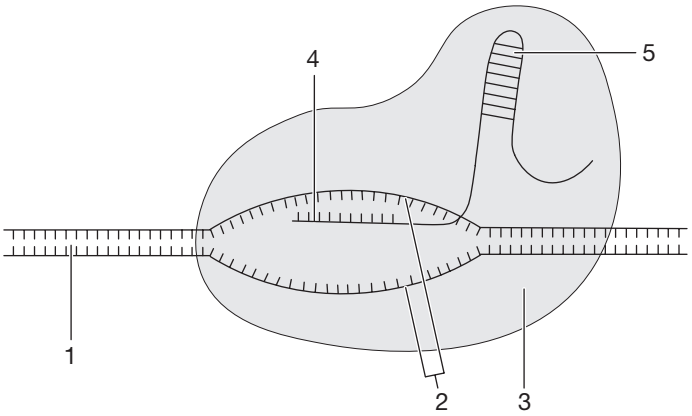
B. 3, 4, 2, 1

C. 7, 6, 5, 2, 1

D. 5, 3, 2, 1

Use the following information to answer Questions 6 and 7.

The diagram below shows the CRISPR-Cas9 complex. This is a new technology that could be superior to other gene editing technologies.



Question 6

What do the components labelled 1–5 in the diagram above represent?

	1	2	3	4	5
A.	DNA	RNA	Cas9	cutting sites	RNA spacer
B.	RNA	Cas9	cutting sites	RNA spacer	scaffold RNA
C.	RNA	cutting sites	Cas9	scaffold RNA	RNA spacer
D.	DNA	cutting sites	Cas9	RNA spacer	scaffold RNA

Question 7

Once a specific section of DNA has been cleaved,

A. new genes can be added to the guide RNA.

B. new genes can be added between the cut sections of the DNA.

C. another enzyme in the cytosol will join the fragments back together.

D. the CRISPR-Cas9 complex is removed from the cell.

Question 8

To produce a transgenic plasmid, a specific restriction enzyme was added to a mixture that contained two different DNA fragments: a plasmid and a small, linear section of DNA that carried a gene to be transferred. The restriction enzyme had one binding site on the plasmid and two binding sites on the linear DNA.

After the addition of the restriction enzyme, how many fragments of DNA would the mixture contain?

A. 2

B. 3

C. 4

D. 5

Question 9

Why are the primers that are used in the process of polymerase chain reaction (PCR) about 20 nucleotides long?

A. The *Taq* polymerase needs to bind to a strand that is 20 nucleotides long.

B. The chance of the target nucleotide strand appearing in the genome more than once is reduced.

C. The primers provide a higher concentration of nucleotides for the extension stage.

D. When the PCR process is complete, the primers are easier to purify and recycle.

Question 10

The PCR process is applied to five strands of DNA.

How many resultant strands would be formed after four complete PCR cycles?

A. 16

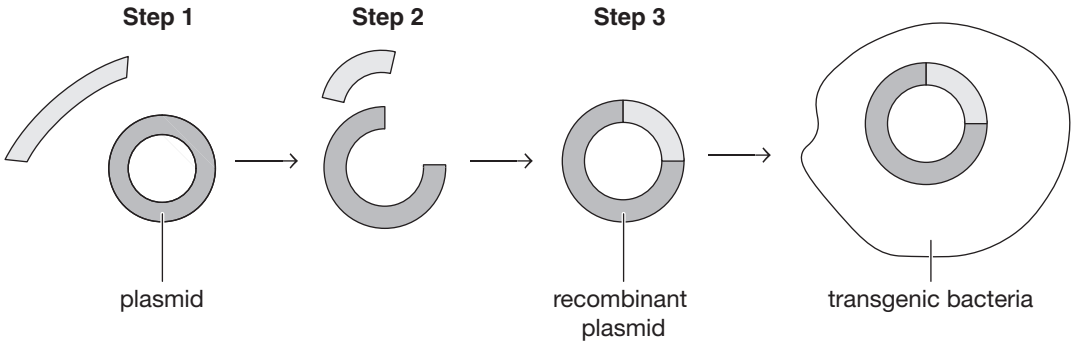
B. 32

C. 40

D. 80

Use the following information to answer Questions 11 and 12.

The diagram below shows the process that leads to the production of transgenic bacteria.



Question 11

For the process shown in the diagram above to have a chance of successfully producing the transgenic bacteria,

A. ligase enzymes would need to be added in step 2.

B. restriction enzymes would need to be added in step 3.

C. shock treatment would need to be applied to the DNA and plasmid in step 1.

D. all steps would need to be carried out at a high temperature.

Question 12

Which one of the following is an example of a positive advancement that has been made using this type of technology?

A. the production of insulin for individuals with type 1 diabetes

B. the insertion of a gene into the salivary gland of a pig

C. the production of antibiotic-resistant bacteria

D. the modification of a human ova to form a superior genome

Use the following information to answer Questions 13–15.

An experiment was conducted to investigate the effect of changed conditions on the rate of photosynthesis in plant leaves. Spinach leaves were cut into small discs and any pockets of air were removed. The spinach discs were exposed to a variety of conditions. The spinach discs were then added to test tubes with 20 ml of water. The time taken for the spinach discs to float in the water was recorded to measure the effect of the varied conditions. The averaged results of the experiment are shown below.

Trial	Conditions	Average time taken for spinach discs to float
1	low light intensity, high temperature	The spinach discs did not float.
2	low light intensity, normal temperature	30 s
3	low light intensity, low temperature	60 s
4	high light intensity, high temperature	The spinach discs did not float.
5	high light intensity, normal temperature	10 s

Question 13

The dependent variable in this experiment is

A. light intensity.

B. temperature.

C. the volume of water in the test tubes.

D. the time taken for the spinach discs to float.

Question 14

The trials that can be directly compared to each other are trials

A. 1, 3 and 5.

B. 1, 2 and 3.

C. 3, 4 and 5.

D. 1, 2, 3, 4 and 5.

Question 15

A reasonable conclusion for this experiment is that

A. low temperature denatures photosynthesis enzymes.

B. low light intensity has more of an effect on photosynthesis enzymes than low temperature.

C. a higher rate of collisions between photosynthetic enzymes and substrates occurs at high light intensity and normal temperature.

D. no light and normal temperature would generate enough oxygen bubbles to cause the spinach discs to float.

Question 16

Which one of the following statements about enzyme structure and function during cellular respiration is correct?

A. Any of the substrates would have a complementary shape to all enzymes involved in the process.

B. Once a reaction is complete, the enzyme needs to be replaced to maintain a constant concentration of the enzyme.

C. A greater number of collisions between an enzyme and a substrate will occur as the temperature increases indefinitely.

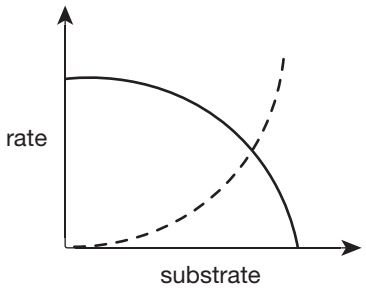
D. Each enzyme could function at a tertiary or quaternary level of arrangement.

Question 17

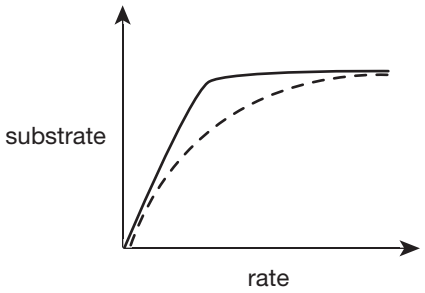
An experiment was conducted to investigate the effect of a competitive inhibitor on an enzyme-driven chemical reaction as the substrate concentration was increased.

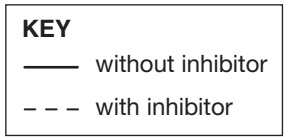
Which one of the following graphs best represents the effect of the inhibitor?

A.

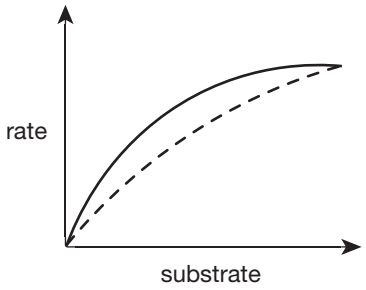


B.

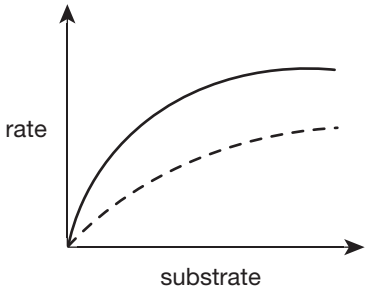




C.



D.



Question 18

The coenzymes used in the light-independent reaction of photosynthesis include

A. ATP and NADH.

B. ADP and NADPH.

C. ADP and NADH.

D. ATP and NADPH.

Question 19

Certain plants combine carbon dioxide with a three-carbon compound (C3) to produce a four-carbon compound (C4) during the night, which can be used in photosynthesis during daylight hours.

This kind of plant is called a

A. C3 plant.

B. CAM plant.

C. C4 plant.

D. Rubisco plant.

Question 20

What is the yield of ATP per glucose molecule in the Krebs Cycle?

A. 1 ATP

B. 2 ATP

C. 4 ATP

D. 36 ATP

Question 21

Isolated mitochondria can be used to investigate the inputs required for aerobic respiration in that organelle.

The inputs required include

A. oxygen and glucose.

B. pyruvate and carbon dioxide.

C. pyruvate and oxygen.

D. glucose and pyruvate.

Question 22

Which one of the following statements about the location of the metabolic pathways is correct?

A. Glycolysis occurs in the stroma.

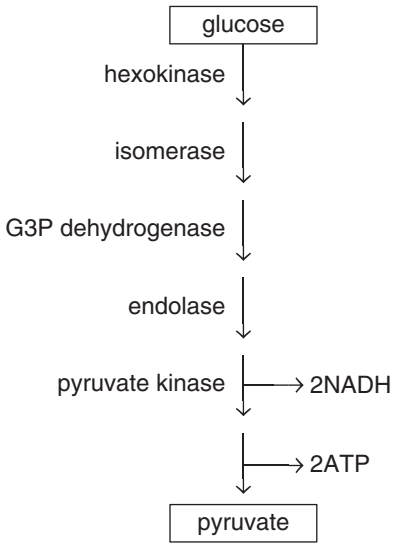
B. Carbon fixation occurs in the matrix.

C. Electron transport occurs along the cristae.

D. The light-dependent reaction occurs in the cytosol.

Use the following information to answer Questions 23 and 24.

The following flow chart illustrates a chemical reaction that occurs in most eukaryotic cells.



Question 23

Based on the information in the flow chart, it is reasonable to conclude that

A. the reaction occurs in the cytosol of eukaryotic cells.

B. the reaction occurs in the matrix of the mitochondria in eukaryotic cells.

C. there is only one enzyme required for this reaction to proceed.

D. the reaction could provide large amounts of energy when oxygen is available to the eukaryotic cell.

Question 24

Pyruvate is more accurately known as pyruvic acid.

If the reaction proceeds uncontrolled in a cell,

A. the resulting higher pH could denature enzymes.

B. the resulting lower pH could provide a non-optimal environment for enzymes.

C. the pyruvic acid would reach a peak concentration and would then decrease.

D. the temperature of the cell would increase, allowing for the more efficient metabolism of glucose.

Question 25

Food security is crucial to provide sustenance for a rapidly growing world population. Improving crop quality in terms of nutritional value, capacity to grow in arid environments and size is essential. For these reasons, genome editing is actively used in staple crop agriculture. The table below illustrates the number of genes that have been altered experimentally over the last five years using CRISPR-Cas9 technology.

Crop	Number of genes altered
orange	1
maize	2
potato	3
tomato	14
rice	34

Based on your knowledge and the information above, which one of the following statements is correct?

A. A gene has been added to tomato cells to change it from a C4 to C3 plant, which uses atmospheric carbon dioxide more efficiently.

B. A gene has been added to potato cells that allows the plant to grow more productively in soil with high salinity.

C. Rice cells require the most genes to be altered to generate a plant with a desirable phenotype.

D. Orange genomes are more difficult to manipulate using CRISPR-Cas9 technology when compared to potato genomes.

END OF SECTION A

SECTION B

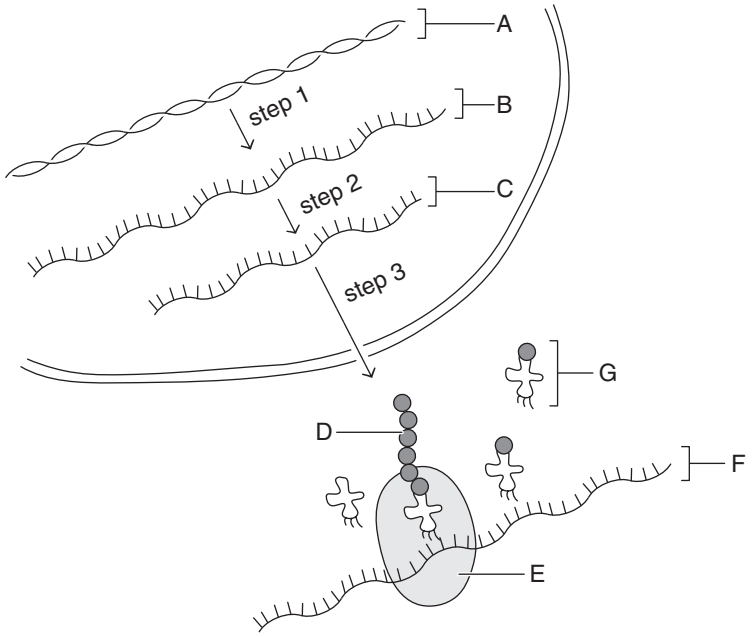
Instructions for Section B

Answer **all** questions in the spaces provided.

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

Question 1 (8 marks)

DNA provides a blueprint to manufacture protein, as shown in the diagram below.



a. Identify the names of step 1, molecule B and structure E. 3 marks

Step 1 _____

Molecule B _____

Structure E _____

b. Outline **two** differences between molecule B and molecule F. 2 marks

_____

_____

_____

c. Identify step 3 and describe how it uses molecule G to produce molecule D. 3 marks

_____

_____

_____

_____

_____

_____

Question 2 (8 marks)

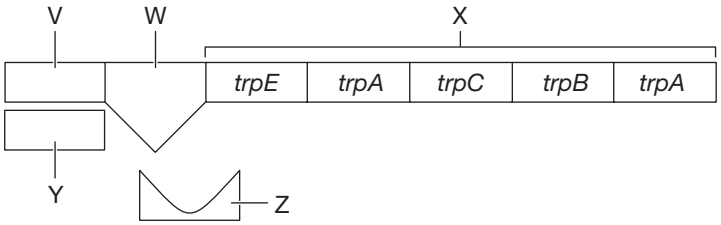
Gene regulation ensures that the appropriate genes are expressed within specialised cells of a multicellular or single-celled organism.

a. Identify the advantage that gene regulation provides for the survival of an organism. 1 mark

Tryptophan is an amino acid. Depending on the type of cell, tryptophan can be gained from the environment or synthesised in a cell.

b. Draw a diagram of the structure of an amino acid and indicate where tryptophan would differ from other amino acids. 2 marks

c. *E. coli* is a type of bacteria. One of the amino acids that *E. coli* needs to survive is tryptophan. If tryptophan is available in the environment, *E. coli* will take it up. If it is not available, *E. coli* can make its own tryptophan using enzymes that are encoded by five genes (*trpA*–*trpE*), which are part of the *trp* operon. The diagram below represents this operon when the levels of tryptophan are low within *E. coli*. Labels V–Z represent different components of the *trp* operon.



i. Name components V and X. 2 marks

Component V _____

Component X _____

ii. Explain how the *trp* operon would function when the levels of tryptophan in the environment are high. 3 marks

Question 3 (6 marks)

The identity of a child's father was disputed and a DNA paternity test was carried out. Samples of DNA were voluntarily taken from the mother, the child and the two potential fathers. The polymerase chain reaction (PCR) was used on each sample, and short tandem repeat 1 (STR 1) was extracted from each sample. STR 1 is a section of DNA that shows some variability in size. As each individual inherits two copies of STR 1, it can be used as a tool to determine individuality.

a. Describe the steps of PCR that enable multiple copies of a specific section of the genome to be amplified. 3 marks

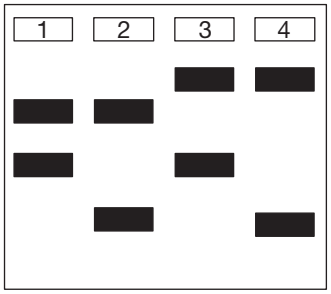
Once amplified, the sections of DNA can be compared to each other through a process of genetic profiling. STR 1 has four variations in size, as shown in the table below.

Variation	Size	Size of sample (simplified)
1	850	0.8 kb
2	923	0.9 kb
3	1026	1.0 kb
4	1580	1.6 kb

The size of the STR 1 alleles of the mother, the child and the two potential fathers was determined by using gel electrophoresis on their DNA samples.

b. Explain why the process is called gel electrophoresis. 2 marks

c. The results of the gel electrophoresis are illustrated below. Lanes 1 and 2 are the potential fathers, lane 3 is the mother and lane 4 is the child.



Which lane contains the DNA of the child's father? Justify your response. 1 mark

Question 4 (8 marks)

Ribulose-1,5-bisphosphate carboxylase-oxygenase (Rubisco) has an important role in combining atmospheric carbon dioxide with the five-carbon molecule ribulose-1,5-biphosphate into energy-rich molecules such as 3-phosphoglycerate (3PGA) and, eventually, glucose. A total of eight large chains and eight small chains are needed to make Rubisco functional.

a. **i.** What type of biomolecule is Rubisco? 1 mark

ii. Where in the cell is Rubisco synthesised? 1 mark

iii. At what level of arrangement does Rubisco function? 1 mark

Magnesium ions are a cofactor needed for the efficient functioning of Rubisco.

b. Describe how carbon dioxide, ribulose-1,5-biphosphate, magnesium ions and Rubisco function together to form an energy-rich molecule such as 3PGA. 3 marks

c. Once the 3PGA is formed, describe how some of the products of the light-dependent reaction enable glucose to be formed. 2 marks

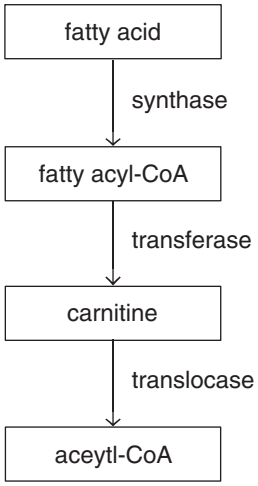
Question 5 (7 marks)

β-oxidation disease is a rare mitochondrial disease that affects about 1 in 7500 people. The disease is caused by defects in the enzymes that convert fatty acids into acetyl coenzyme A (acetyl-CoA).

a. Draw a labelled diagram of a mitochondrion showing the location of the **two** stages of respiration that occur in it. 2 marks

b. What is the function of acetyl-CoA within mitochondria? 1 mark

The diagram below illustrates the pathway that occurs during the metabolism of fatty acids into acetyl-CoA.



c. Some individuals with *β*-oxidation disease form translocase that does not function properly. Describe **two** consequences of the disease if fatty acids are consumed. 2 marks

d. Fatty acids are the product of the breakdown of fat. Per gram, fatty acids carry more potential chemical energy than glucose. It is recommended that individuals who are affected by β-oxidation disease eliminate fat from their diet to alleviate some of the symptoms of the disease.

i. Outline a symptom that may result if an individual with β-oxidation disease eliminates fat from their diet. 1 mark

ii. Outline how an individual with β-oxidation disease could alleviate the symptom outlined in **part d.i.** 1 mark

Question 6 (8 marks)

Most indoor plants do not need a lot of light to grow. If they are neglected for an extended period, these plants are often resilient enough to survive without growing. However, not all indoor spaces provide the ideal amounts of air, light and water that an indoor plant requires.

a. Explain how each of the following substances contributes to plant growth and identify the specific cellular location where it is utilised.

i. air 2 marks

ii. water 2 marks

b. Many indoor plants can thrive in low light intensity.

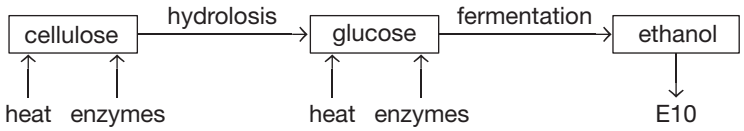
Suggest **two** ways in which an indoor plant might vary in composition to an outdoor plant to allow this to occur. 2 marks

c. If a plant is neglected, it may remain alive without growing.

Explain how this would occur. 2 marks

Question 7 (5 marks)

Ethanol can be used as a blending agent with petrol (E10) to reduce pollution. Ethanol is a renewable fuel that can be made commercially from various plant materials (biomass). One option is to convert cellulose, the non-edible, fibrous material that constitutes the bulk of plant matter. The steps involved in the production of ethanol from cellulose are shown in the diagram below.



a. Explain why the hydrolysis of cellulose into glucose uses heat and enzymes. 3 marks

b. Describe the conditions required for the fermentation of glucose into ethanol.
In your answer, include **two** inputs and **two** outputs of the process. 2 marks

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2022

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