Trial Examination 2006

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	Suggested times (minutes)
A	25	25	25	30
B	7	7	50	60
			Total 75	90

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 white out liquid/tape. No calculator is allowed in this examination.

Materials

Question and answer booklet of 19 pages.
Answer sheet for multiple-choice questions.

Instructions

Write your **name** and **teacher's name** on this booklet and in the space provided on the answer sheet for multiple-choice questions. All written responses should be in English.

At the end of the examination

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

Students are NOT permitted to bring mobile phones and/or any other electronic communication 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 2006 VCE Biology Unit 3 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 **best answers the question**.

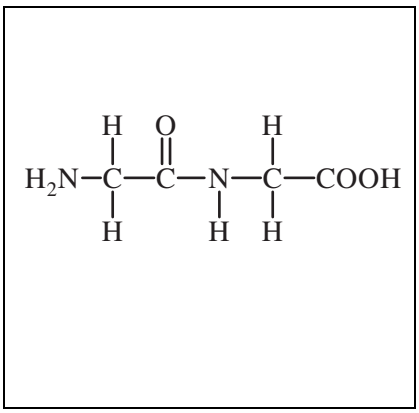
A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

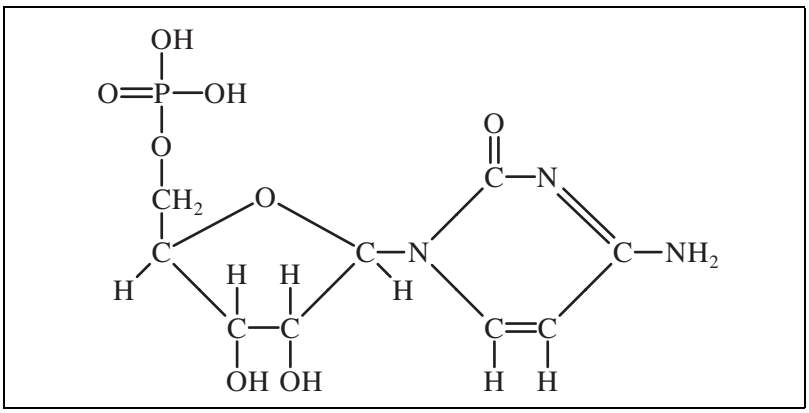
No marks will be given if more than one answer is completed for any question.

The diagrams below illustrate the chemical structure of some biomolecules.
Use them to answer Questions 1 and 2.

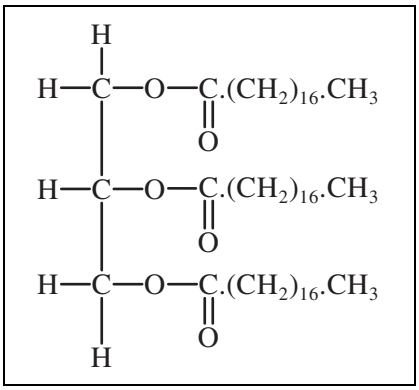
W



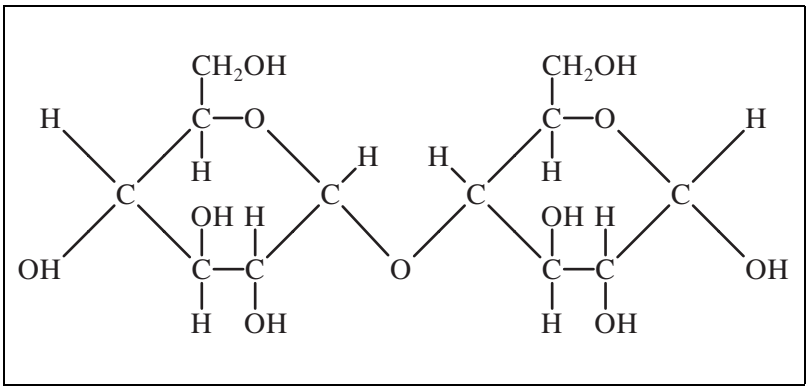
X



Y



Z



Question 1

Which molecule(s) make up the chemical structure of proteins?

A. *W* only

B. *X* only

C. *W* and *X*

D. All of them

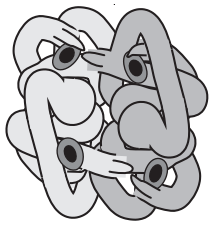
Question 2

Which molecule(s) was/were formed by condensation reactions?

A. *W*, *X* and *Z*
B. All of them
C. *X* only
D. *Z* only

Use the following information to answer Question 3.

The figure below shows a single molecule of haemoglobin, an oxygen-transporting protein found in red blood cells. The molecule consists of four polypeptide chains.



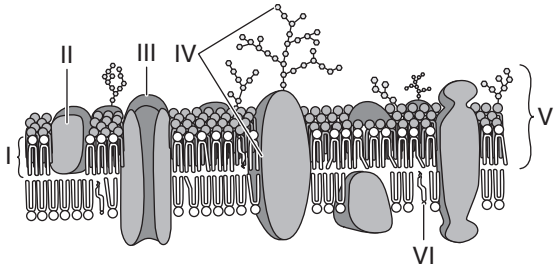
Question 3

Which term best describes the three-dimensional structure of haemoglobin?

A. primary
B. secondary
C. tertiary
D. quaternary

Use the following information to answer Question 4.

The diagram below represents the structure of the plasma (cell) membrane.



Question 4

Which structure(s) represent glycoproteins?

A. I and VI
B. II, III and IV
C. IV and V
D. IV only

Question 5

Which measurement best represents the approximate width of the cell membrane?

A. 7.5 μm
B. 7.5 mm
C. 7.5 nm
D. 7.5 cm

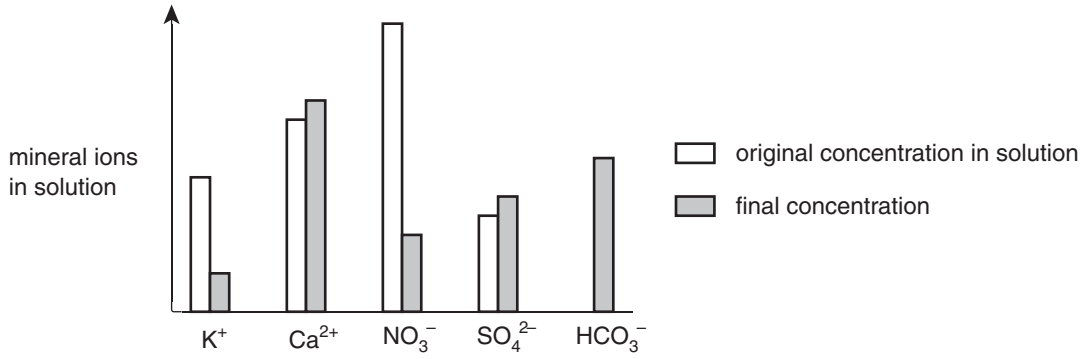
Question 6

Simple diffusion in plants is sufficient to account for

A. absorption of water by root hairs.
B. transport of potassium ions through protein channels in the cell membrane.
C. the secretion of cellulose to form the cell wall.
D. exchange of oxygen and carbon dioxide within the leaves.

Use the following information to answer Question 7.

Tomato plants can be grown in sterile culture solutions using a technique called hydroponics. The graph below shows the changes in the concentrations of certain mineral ions in a culture solution in which tomato plants have been grown for 24 hours.



Question 7

Which of the following ions appear to have been taken up from the solution by active transport into the roots?

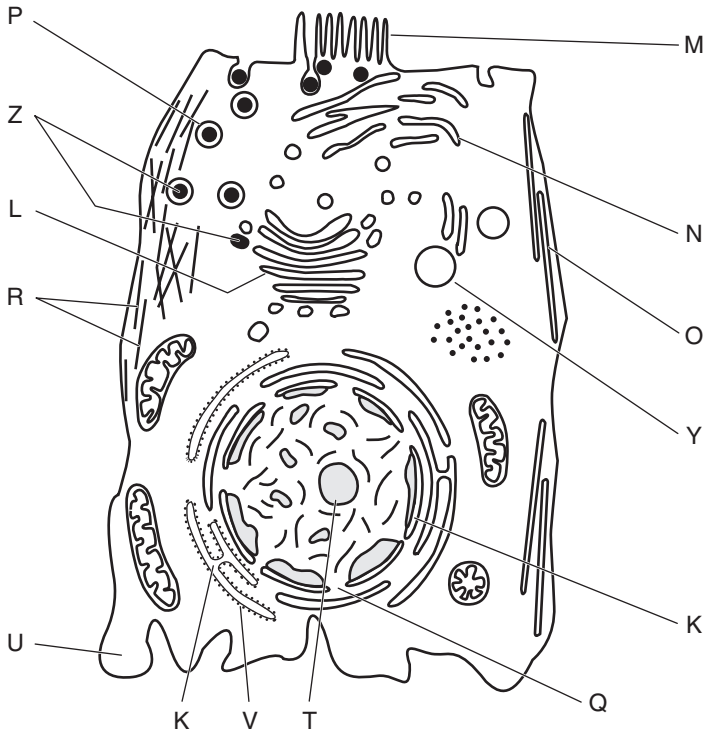
A. K^+ and HCO_3^-
B. Ca^{2+} and SO_4^{2-}
C. K^+ and NO_3^-
D. HCO_3^- only

Question 8

Which one of the following is a correct summary of the main events in photosynthesis?

A. Light is required to join carbon dioxide to hydrogen (which was split from water using ATP) in carbohydrate production.
B. Oxygen reacts with a carbohydrate to produce water and carbon dioxide in the presence of light.
C. Light splits carbon dioxide, producing oxygen gas, and the resulting carbon then combines with oxygen and hydrogen obtained from water to produce carbohydrate.
D. Carbon dioxide combines with hydrogen split from water by light to produce carbohydrate using ATP.

For Questions 9 and 10, study this view of an animal cell as seen using an electron microscope.



Question 9

What is the polysaccharide found at X?

A. ATP
B. glucose
C. glycogen
D. starch

Question 10

In this cell, lipase and amylase molecules are produced by protein synthesis and secreted in large quantities. Which sequence of letters best describes the route taken by a radioactively-labelled amino acid as it is incorporated into an enzyme molecule prior to secretion?

A. T → Q → U → Y → Z → P
B. U → V → L → N → Z → P
C. T → Q → V → M → O → R
D. U → V → K → L → Z → P

Question 11

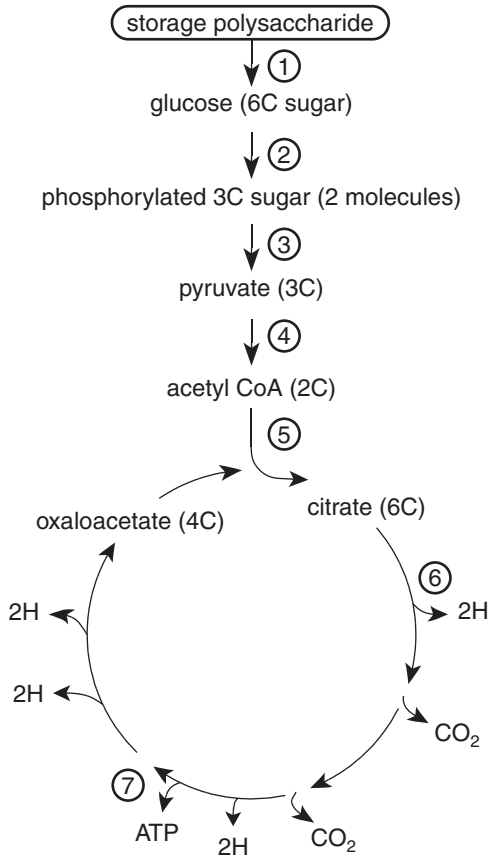
Adenosine triphosphate, ATP, provides energy within the cell. When ATP is used, the reaction may be summarised as

$$ATP \rightarrow ADP + P_i + \text{energy}$$

Which of these statements concerning this reaction is **correct**?

A. The reaction is endergonic.
B. ATP contains a base, a sugar and two phosphate groups.
C. The reaction is catabolic.
D. This reaction takes places mainly in the mitochondria.

*Questions 12 and 13 refer to the following diagram, which represents **some** of the biochemical reactions of aerobic respiration.*



Question 12

Which row of this table gives the correct information about the diagram?

	Numbered steps	Stage of respiration	Location in the cell
A	1 to 4	glycolysis	matrix of mitochondrion
B	1 to 4	glycolysis	cytosol
C	5 to 7	Krebs cycle	cristae of mitochondrion
D	5 to 7	electron transport chain	cristae of mitochondrion

Question 13

Using the information on the diagram and your knowledge of aerobic respiration, it is correct to conclude that

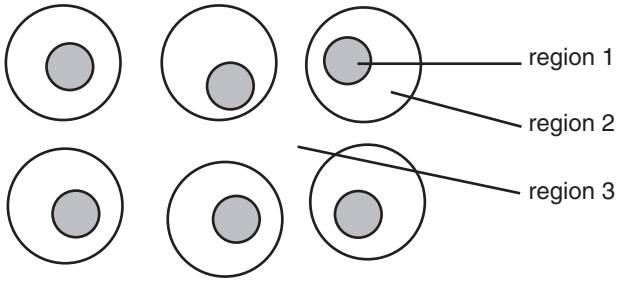
A. the hydrogen released by numbered steps 5 to 7 passes through the electron transport chain to combine with oxygen to form water.

B. in numbered steps 1 to 4, ATP is neither consumed nor produced.

C. numbered steps 5 to 7 represent the main ATP-producing stage of aerobic respiration.

D. the oxygen required by aerobic respiration is used to form carbon dioxide between numbered steps 6 and 7.

Questions 14 and 15 refer to the following diagram of human body cells as seen using a light microscope.



Question 14

Which area from the diagram represents the extra-cellular environment?

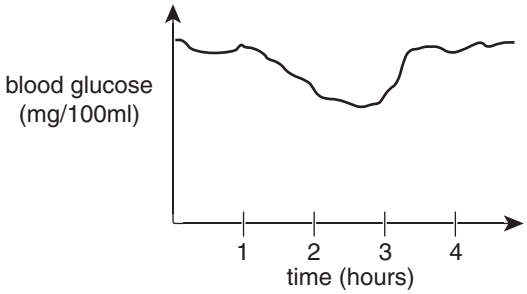
A. Region 1
B. Region 2
C. Region 3
D. Regions 1, 2 and 3

Question 15

Which of the areas from the diagram would you expect to be approximately 37 °C?

A. Region 1
B. Region 2
C. Region 3
D. Regions 1, 2 and 3

Questions 16, 17 and 18 refer to the following graph which illustrates the body's response to a drop in the level of blood glucose over time.



Question 16

After 3 hours, the body could reasonably be expected to be

A. secreting glucose from cells that have been storing it as glycogen.
B. secreting hormones that stimulate the uptake of glucose from the bloodstream.
C. converting glucose to glycogen in muscle tissue.
D. converting protein to glucose in the liver cells.

Question 17

This graph depicts

A. exocytosis.
B. nervous control.
C. homeostasis.
D. positive feedback.

Question 18

Hormones are responsible for keeping factors such as blood glucose within a narrow range. Which of the following factors is an action a hormone could reasonably be expected to take?

A. A reaction with a membrane receptor that will lead to a cellular change.
B. Be released from exocrine tissue.
C. Circulate in the bloodstream directly to the target tissue.
D. A more rapid response than the action of nerves.

Question 19

Many plants control gas exchange through small pores in their leaves called stomata. Cells of the stomata (guard cells) are able to control the amount of gas exchange by regulating their turgor. The more turgid the guard cell, the greater the gas exchange through the stomata. Turgor in guard cells is triggered by potassium pumps in the membrane that, when activated, allow potassium ions to accumulate inside - which leads to the cell's turgidity.

Which of the following statements is consistent with the information above?

A. An inhibitor that interfered with the action of these potassium pumps would increase the rate of gas exchange.
B. When the guard cells are turgid during the day, carbon dioxide would be moving from the leaf to the air.
C. The accumulation of potassium ions inside these cells makes that environment more hypertonic than prior to potassium pumps being activated.
D. A way of reducing gas exchange could be to activate the potassium pumps.

Question 20

Which of these responses to external stimuli produces growth of the plant toward light?

A. negative geotropism
B. negative phototropism
C. positive geotropism
D. positive phototropism

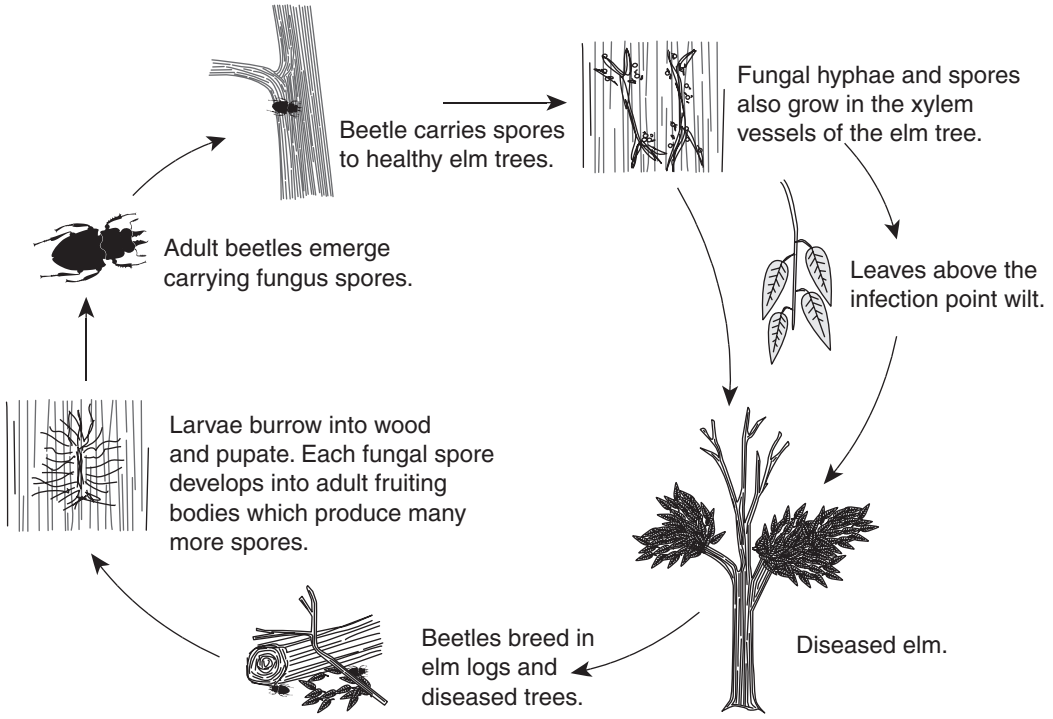
Question 21

Which plant hormone, developing in an apical bud, inhibits the growth of lower buds?

A. abscisic acid
B. auxin
C. cytokinin
D. gibberellin

Questions 22 and 23 refer to the following information.

The following life cycle is that of Dutch elm tree disease, caused by the fungus *Ophiostoma novo-ulmi*. Bark beetles act as a vector; when mature, they carry the fungal spores from tree to tree. This is a problem on many Victorian streets that are lined with mature elm trees that are difficult to replace.



Life cycle of Dutch elm disease

Question 22

The most effective method of reducing the spread of Dutch elm disease would be to

A. spray the infected trees with a fungicide.
B. eradicate the bark beetles with insecticide.
C. remove the defoliated parts of the diseased elm trees.
D. remove the leafy portions of the diseased elm trees.

Question 23

A fungus such as *Ophiostoma novo-ulmi* could be described as

A. a prokaryotic heterotroph.
B. an autotrophic eukaryote.
C. a multicellular eukaryote.
D. a unicellular prokaryote.

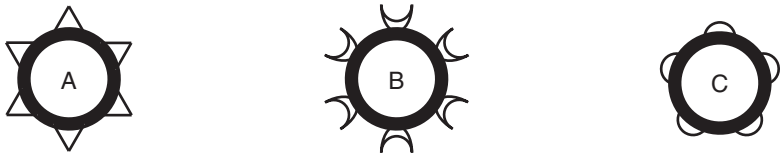
Question 24

Which of the following cells of the immune system are primarily involved with the production of chemicals that destroy virus-infected cells?

A. mast cells
B. natural killer cells
C. dendritic cells
D. macrophages

Use the following information to answer Question 25.

The diagram below depicts three strains of virus (A, B and C) with different types of antigens exposed. Each antigen is unique to each strain of virus.



Question 25

If a person becomes infected with strain C, which of the antibodies depicted below would the body synthesise to eradicate that strain?

A.


B.


C.


D.


SECTION B: SHORT-ANSWER QUESTIONS

Instructions for Section B

Answer this section in **pen**.

Answer all questions in the spaces provided.

Question 1

Antibiotics work by interfering with some essential operations in bacterial cells. Penicillin and cephalosporin both inhibit the synthesis of the bonds that strengthen bacterial cell walls. These walls consist of long, linear polymers called peptidoglycans.

Peptidoglycan molecules are cross-linked by peptide chains. Antibiotics inhibit the synthesis of the peptide links, resulting in a weak cell wall through which the bacterium explodes. Because they work during the synthesis of the cell wall, these antibiotics are active against bacteria only when they are growing.

Chloramphenicol and streptomycin interfere with protein synthesis by binding to the ribosomes. Streptomycin, for example, distorts the ribosome and thus causes an error in reading the genetic code so that the wrong amino acid is inserted into the growing peptide chain. This effect, however, is likely to be less rapid than the irreversible halt to protein synthesis that occurs within minutes of adding the antibiotic rifampicin to a bacterial culture.

The above text is adapted from "Antibiotics Explained: A post-16 study resource" by J. Cherfas published by The Biotechnology and Biological Sciences Research Council (1995). Used with permission.

a. Define the following terms.

i. polymer

_____

_____

_____

1 mark

ii. peptide chain.

_____

_____

_____

1 mark

b. Explain how a 'weak cell wall' can cause a bacterium to 'explode'.

_____

_____

_____

_____

2 marks

c. Rifampicin acts by preventing transcription.

i. Which nucleic acid would be prevented from forming?

_____

1 mark

ii. Describe how preventing transcription would cause an 'irreversible halt to protein synthesis' in a bacterium.

_____

_____

_____

_____

2 marks

Total 7 marks

Question 2

a. **i.** State the components needed to synthesise a triglyceride.

_____

1 mark

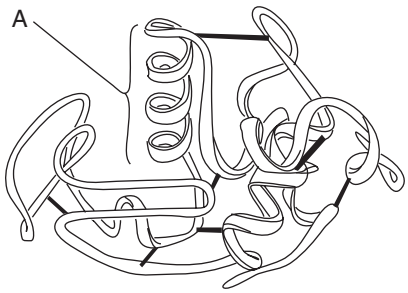
ii. State **one** function of triglycerides in living organisms.

_____

1 mark

Lipase is an enzyme that catalyses the hydrolysis of triglycerides. It is a soluble globular protein. The function of an enzyme depends upon the precise nature of its tertiary structure.

The diagram below represents the structure of an enzyme. The black strips represent the disulfide bonds that help to stabilise its tertiary structure.



b. **i.** Region A in the above diagram is a secondary structure. What is this secondary structure called?

_____

1 mark

ii. Explain why the function of an enzyme depends upon the precise nature of its tertiary structure.

_____

_____

_____

_____

2 marks

iii. Describe the effect of breaking the disulfide bonds on lipase function.

_____

_____

_____

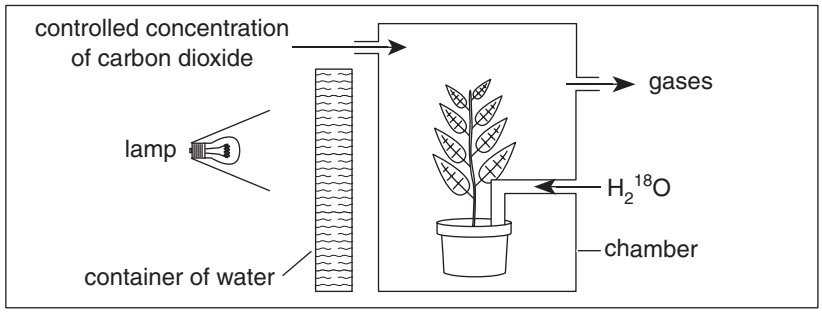
_____

2 marks
Total 7 marks

Question 3

The diagram below shows a pot plant inside a chamber in which the concentration of carbon dioxide and the temperature were controlled. The chamber was placed in a dark room. The plant was then supplied with 'labelled' water ($H_2{}^{18}O$) and exposed to light from a lamp.

The lamp was placed at measured distances from the plant and the light intensity was calculated. The volume of oxygen produced by the plant was measured in cubic centimetres per hour.



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

Distance from lamp to plant (cm)	Light intensity (arbitrary units)	Volume of $^{18}O_2$ evolved by the plant ($cm^3\ h^{-1}$)
Lamp off	0	0.0
40.0	6	0.3
30.0	11	0.8
20.0	25	1.3
15.0	40	1.9
10.0	100	3.5
7.5	175	8.0
5.0	400	52.0

a. Explain why a container of water was placed between the lamp and the chamber.

_____

_____

1 mark

b. Write a balanced chemical equation for the biochemical process by which oxygen is produced in the leaves of the illuminated plant.

2 marks

c. Using data from the table, describe the relationship between the light intensity and the volume of oxygen evolved.

_____

_____

_____

2 marks

d. State **two** conclusions about the process of photosynthesis that can be drawn from the results about how the leaves of the pot plant produced $^{18}O_2$.

_____

_____

_____

_____

2 marks

e. Variegated plants have green and white patterned leaves, resulting from a lack of chlorophyll in some leaf cells. A second pot plant with variegated leaves was tested under identical conditions and it was found that less oxygen was produced at all light intensities.

i. State **precisely** where chlorophyll is found in a chloroplast.

_____

1 mark

ii. What precaution must be taken to ensure that the results of this second experiment can be accurately compared to the results of the first experiment?

_____

_____

_____

1 mark

Total 9 marks

Question 4

Some results of research recently conducted suggest a link between marijuana use and a reduction in memory and reduction in neuron size. The active ingredient in marijuana is THC and when in the bloodstream the THC moves to the brain and binds with receptors on the cell surface of neurons.

The interaction between the THC and 'cannabinoid' receptor (CB-receptor) has an inhibitory effect on neuron function.

a. **i.** What is a function of a neuron?

_____

1 mark

ii. What is the specific stimulus of the inhibitory effect displayed in this case?

_____

1 mark

One of the impacts of this combination of the THC and CB-receptor is inhibition of nerve impulse-dependent calcium channels which, when stimulated, promote exocytosis from the pre-synaptic membrane of the neuron.

b. Use this information to describe the effect of THC on a functioning synapse.

_____

_____

_____

2 marks

Another aspect of research revealed that when THC bound with the CB-receptor, it also inhibited a biochemical pathway that normally led to the accumulation of proteins in the cytoplasm of the neurons. This is thought to lead to reduced cell size as well as cell death.

c. Give a biological explanation as to why reduced protein synthesis may lead to cell death.

_____

_____

_____

2 marks

Total 6 marks

Question 5

Apple farmers often use artificial environments to ensure their apples are available to consumers all year round. One such method is to accelerate fruit ripening by exposing large quantities of apples to a specific set of conditions.

An experiment was carried out to test the effect of varying the levels of a plant hormone ethylene on apple ripening when exposed to different temperatures. Testing was conducted in aluminium containers that had 100 equally sized unripe apples placed in them. The internal environment of the aluminium containers could be altered by adding or removing factors in the air by an inlet and outlet valve.

The apples were considered ripe when two apples could be consecutively removed and deemed ripe by tasting them for sweetness as well as looking at their colour. Results of such an experiment are outlined in the table below.

Ethylene concentration (ppm)	Temperature (°C)	Time taken for apples to ripen (hours)
0	20	200
1	20	150
2	20	100
50	20	75
150	20	30
500	20	30
500	5	100

a. **i.** List one strength in the experimental design.

_____

1 mark

ii. List one weakness in the experimental design.

_____

1 mark

iii. Use the experimental results to describe the optimal conditions you would recommend to apple farmers for fast fruit ripening.

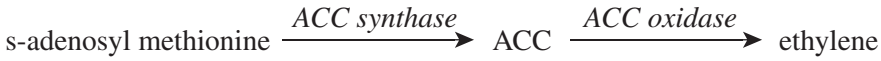
_____

_____

_____

2 marks

Ethylene is produced by some plant cells via a series of biochemical reactions as outlined below. Each step is catalysed by an enzyme.



It has been shown that small quantities of ethylene will induce the gene for ACC synthase to produce more enzyme.

b. **i.** Explain why the action of ethylene on the production of ACC synthase would be regarded as an example of positive feedback.

_____

_____

_____

_____

2 marks

ii. Use this information, as well as the data table, to explain the difference in the rate of ripening for the different temperatures the apples were exposed to in the experiment.

_____

_____

_____

2 marks

Total 8 marks

Question 6

There have been major concerns about the avian influenza virus (bird flu) infecting humans and possibly causing a worldwide pandemic. The bird flu is one of many different subtypes of type A influenza viruses. These subtypes differ because of changes in certain antigenic proteins on the surface of the influenza A virus. The proteins are symbolized with the letters H (hemagglutinin) and N (neuroaminidase).

H1N1, H1N2 and H1N3 are the strains of the influenza A virus currently affecting the human population. However, they are usually only suffered for a week and the victims generally survive. On the other hand, the bird flu is the variant form H5N1 and humans have rarely been exposed to this strain. When contracted by humans, this form of the flu is generally very severe. The symptoms can range from high temperatures to brain swelling and death.

The H5N1 strain is usually contracted from infected birds and it is rare for humans to pass this strain of flu onto other humans.

a. Draw a labelled diagram of a typical virus.

2 marks

b. The viral DNA in the H1N3 and H5N1 strains is different. Explain why this leads to different antigenic proteins on their surfaces.

_____

_____

_____

1 mark

c. The table below illustrates the number of confirmed cases from the World Health Organisation of humans who have contracted the bird flu in the recent past.

Year of onset	Total cases reported	Number of deaths
2003	3	3
2004	46	32
2005	89	36

What has happened to the percentage of mortality over the last three years?

_____

1 mark

d. Research is currently being conducted at a frenzied pace in an effort to develop a vaccine for the bird flu so that a possible pandemic may be thwarted.

i. What does a vaccine contain?

_____

_____

1 mark

ii. If, after being vaccinated, a person was infected with the bird flu, how would you expect this person's immune system to respond?

_____

_____

_____

_____

_____

3 marks

Total 8 marks

Question 7

There are several factors that are taken into account when determining the compatibility of a potential organ donor. These are outlined below in order of importance:

- **ABO Blood types.** Blood types of the donor and recipient should be the same. There are four blood types: A, B, AB and O.
- **Rhesus factor.** This can either be negative or positive which should match with the recipient and the donor.
- **Tissue matching.** The cells of the recipient and the donor should be as similar as possible with respect to a group of six antigens (called HLA proteins) located on the surface of all body cells.

a. Define the term antigen in the context of this question.

_____

1 mark

A certain individual who is blood type B positive is in need of a kidney transplant and luckily two potential donors are available at the same time. Their compatibility, with respect to the factors above, follows:

- Person 1: Blood type B negative and five of the antigens are a perfect match.
- Person 2: Blood type B positive and three of the antigens are a perfect match.

b. Based on the information provided, explain which person (1 or 2) would be the best donor.

_____

_____

1 mark

c. Using the information provided as well as your understanding of the immune system, explain why the risk of rejection of the transplanted organ still exists even if all the factors outlined above are a perfect match.

_____

_____

_____

2 marks

d. Describe a measure that could be taken which could reduce the risk of rejection of the transplanted organ.

_____

_____

1 mark

Total 5 marks

END OF QUESTION AND ANSWER BOOKLET