

Trial Examination 2010

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 white out liquid/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 **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.

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 2010 VCE Biology Unit 3 Written Examination.

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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** for 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.

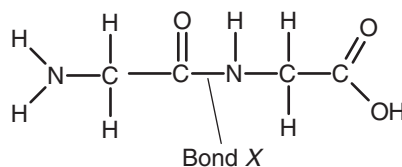
Question 1

Glycogen is

- A. a hormone.
- B. a protein.
- C. a lipid.
- D. a carbohydrate.

Question 2

The following diagram is of a biomolecule.



Bond X is

- A. a peptide bond.
- B. a phosphodiester bond.
- C. an ionic bond.
- D. a glycosidic bond.

Question 3

Which of the following is an example of an organelle, its correct function and biomolecular composition?

	Organelle	Function	Biomolecular composition
A.	nucleus	control	DNA and histone
B.	ribosome	protein synthesis	DNA and tRNA
C.	lysosome	digestion	enzymes and RNA
D.	Golgi	transport	protein and nucleotides

Question 4

A single stranded DNA molecule has the following sequence of nucleotides:

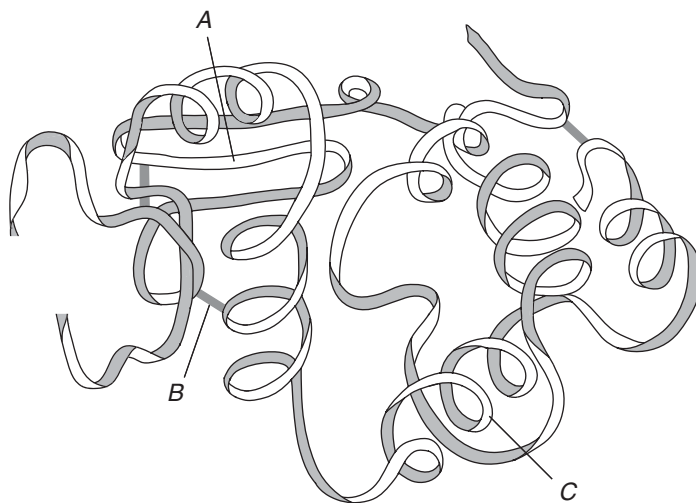
GGTAACCATAGGACTAG

The complimentary DNA strand to this molecule would be

- A. GGTAACCATAGGACTAG.
- B. CCUTTGGTUTCCTGUTC.
- C. CCATTGGTATCCTGATC.
- D. CCAUUGGUAUCCUGAUC.

Question 5

The following diagram is of the three dimensional structure of a globular protein.

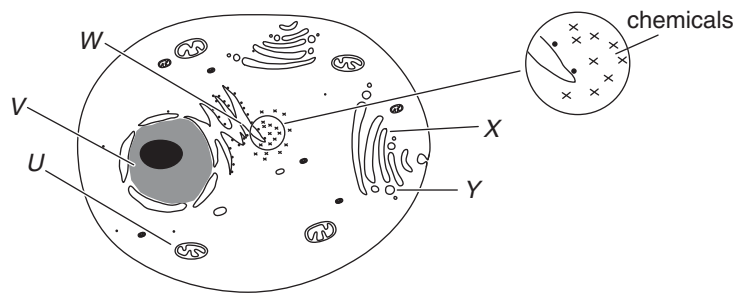


The sections of the protein labelled *A*, *B* and *C* in order are

- A. β sheets, α helices and disulfide bonds.
- B. disulfide bonds, β sheets and α helices.
- C. α helices, disulfide bonds and β sheets.
- D. β sheets, disulfide bonds and α helices.

Questions 6 and 7 refer to the following information.

The following diagram refers to a cell that is synthesising and secreting a hormone.



Question 6

The chemicals labelled within the cell would likely be

- A. used to break down the main biomolecule found in the mitochondria.
- B. the products of a reaction occurring in the golgi.
- C. the substrates of a reaction that occurs on the endoplasmic reticulum.
- D. a membrane bound in a vesicle.

Question 7

The correct order of organelle involvement for the synthesis and eventual secretion of the hormone from the cell would be

- A. V W X Y.
- B. U V W X Y.
- C. W V X Y.
- D. Y X W V.

Question 8

Read the following statements about the phospholipid bilayer that makes up the cell membrane.

- I. It is a fluid layer of completely hydrophobic (non-polar) molecules.
- II. Phospholipid molecules move constantly along the plane of the membrane.
- III. Proteins embedded in the membrane can act as hydrophilic channels for molecules entering or exiting the cell.
- IV. Molecules can only enter or exit the cell through trans-membrane proteins.

Of the above

- A. I, II, III, and IV are true.
- B. II, III, and IV are true.
- C. I and II are true.
- D. II and III are true.

Question 9

If the concentration of CO_2 suddenly increases in the air surrounding a plant, the plant is most likely to respond by

- A. photosynthesising less because excess CO_2 damages chlorophyll.
- B. photosynthesising more because CO_2 concentration often limits the rate of photosynthesis.
- C. increasing its rate of transpiration to aid gas exchange with the atmosphere.
- D. increasing its rate of O_2 uptake to balance out the increase in CO_2 .

Question 10

Within cells, glycolysis occurs in the

- A. cytoplasm.
- B. cytosol.
- C. mitochondrial cristae.
- D. mitochondrial matrix.

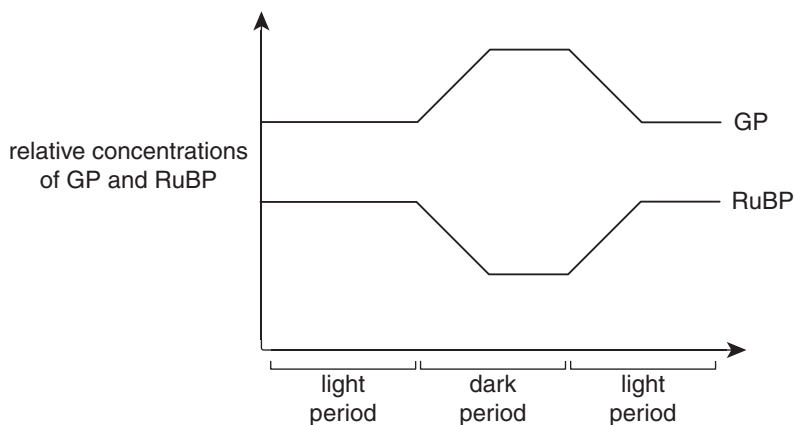
Question 11

A scientist designed a chemical insecticide that specifically inhibits mitochondrial electron transport in a particular type of insect. When the chemical is given to the insect it will result in

- A. a stimulation of ATP synthesis.
- B. an increase in the pH of the mitochondrial matrix.
- C. a decrease in O_2 consumption.
- D. an increase in NADH consumption.

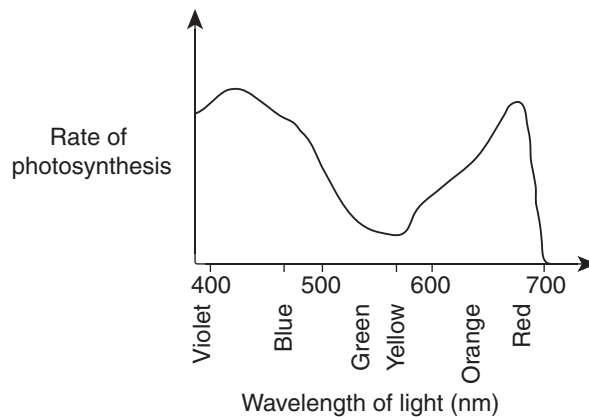
Question 12

The following graph shows the relative concentrations of glycerate-3-phosphate (GP) and ribulose biphosphate (RuBP) in a chloroplast during alternating periods of light and dark.



Within the chloroplast, GP and RuBP would be found in

- A. the grana.
- B. the stroma.
- C. the thylakoid membrane.
- D. the chlorophyll.

Question 13

From the photosynthetic action spectrum in the figure above, it is reasonable to conclude that

- A. chlorophyll absorbs more green than red light.
- B. plants can use all colours of visible light for photosynthesis.
- C. light in the green range produces the most efficient photosynthesis.
- D. there are two photosystems in leaves: one for red light, one for blue light.

Question 14

Researchers compared the survival rates of people subjected to temperatures beyond the normal tolerance range for humans. People whose temperature was raised above normal by 6–7°C for some time almost always died. Those who had been immersed in icy water causing their temperature to decrease by 6–7°C usually survived.

This is because

- A. the metabolic rate can not keep up with the body's requirements at high temperatures due to the denaturation of enzymes.
- B. low temperatures reduce the effects of dehydration allowing the body to return to normal quickly.
- C. the metabolic rate at high temperatures produces large amounts of wastes that can not be removed, therefore producing a toxic effect on cells.
- D. heat transfer to a cold person is much more efficient than heat transfer from a hot person.

Question 15

Of the following, an example of a negative feedback system is

- A. the more you scratch, the more it itches, so the more you scratch.
- B. during childbirth, the pressure of the baby's head on the cervix causes the release of a hormone that increases the strength of muscle contractions in the birth canal.
- C. as blood sugar levels increase, insulin is released, signalling cells to take up sugar.
- D. pressure on the car brake during a quick stop causes forward momentum on the driver, causing an increase in pressure on the brake.

Question 16

Jack sold his cow for some bean seeds. He put the dry seeds in some damp soil and noticed they didn't grow. A friend told him he should soak them in water in order to 'wash out' a certain plant hormone that was in high concentration within the seed coat.

The hormone his friend was talking about is

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

Question 17

Hypersensitivity results from

- A. cytotoxic T cells attacking 'self' cells when not suppressed after an infection.
- B. receptors on target cells failing to recognise signalling molecules.
- C. excessive histamine from mast cells causing the swelling of tissues.
- D. repeated stimulation of synapses in sensory organs.

Question 18

Cholinesterase is an enzyme that catalyses the hydrolysis of the neurotransmitter, acetylcholine. It is a membrane-bound enzyme found on the post-synaptic cell surface.

The effect of a substance that blocks the action of cholinesterase at a synapse would be that

- A. the receptor channels in the post-synaptic membrane would not open and a nerve impulse would not be conducted across the synapse.
- B. acetylcholine would be broken down and would not diffuse across the synaptic gap for neural excitation to occur.
- C. acetylcholine would not be released from synaptic vesicles in the pre-synaptic neuron.
- D. acetylcholine would build up and the synapse would not recover after a nerve impulse had been transmitted across it.

Question 19

Melanocyte-stimulating hormone (MSH) is a peptide hormone. In frogs, only a few molecules of MSH are required to trigger large changes in melanocytes (specialised skin cells that contain the dark brown pigment melanin).

From the following options the best explanation for this observation is that

- A. the hormone molecules persist for years and can repeatedly activate the same melanocyte.
- B. the hormone is lipid soluble and readily penetrates the membranes of the melanocytes.
- C. the hormone amplifies the production of second messengers within the melanocyte.
- D. the hormone is rapidly replicated within each melanocyte.

Question 20

Organ transplant patients are given drugs to minimise the rejection of transplanted organs.

These drugs work by

- A. inhibiting the production of enzymes by the transplanted organ that lead to rejection.
- B. suppressing the immune response that recognises 'foreign' molecules on the transplanted organs.
- C. acting as antibiotics so that bacteria are killed before causing infections in transplanted organs.
- D. promoting the repair of the blood vessel connections between the transplanted organ and the host body.

Question 21

An **endophyte** is often a bacterium or fungus, that lives within some plants without causing apparent disease. Endophytes may benefit host plants by preventing pathogenic organisms from colonising them. Extensive colonisation of the plant tissue by endophytes creates a ‘barrier effect’, where the local endophytes outcompete and prevent pathogenic organisms from taking hold.

The presence of endophytes within some plants is an example of

- A. a physical barrier to infection.
- B. a specific response to a stimulus.
- C. a non specific response.
- D. a pheromone.

Question 22

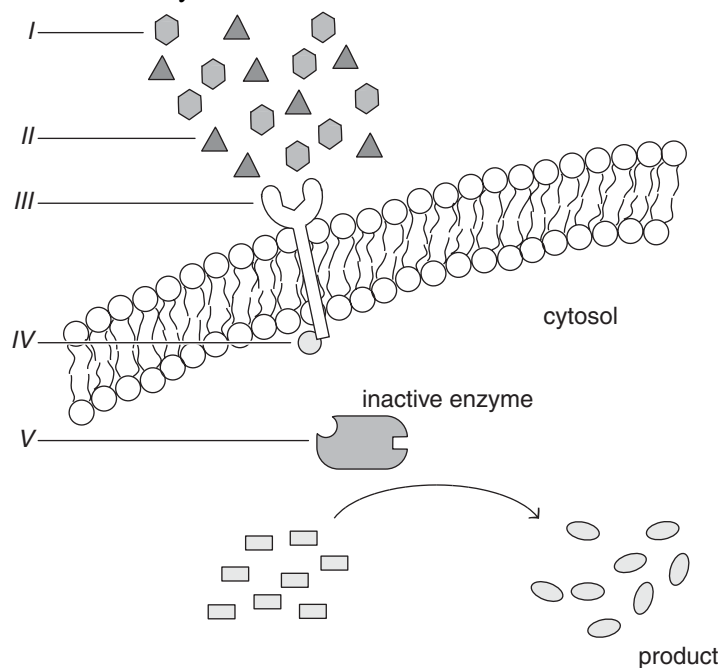
Multiple sclerosis is an autoimmune disorder in which the body’s immune system attacks and destroys the myelin of its own nervous system.

The effect of this damage on the nervous system is

- A. the cell bodies of nerve cells can no longer reach action potential because the myelin receptors that take up sodium have been damaged.
- B. degraded myelin molecules block receptor proteins in the post-synaptic membrane so impulses cannot be conducted across synapses.
- C. lack of myelin decreases production of acetylcholine (a neurotransmitter), disrupting muscular coordination.
- D. axons conduct nervous impulses less effectively because their insulating sheaths have been damaged.

Question 23

The following is a diagrammatic representation of signal transduction where a ligand binds to a receptor which leads to the activation of an enzyme.



Accumulation of a product via this signal transduction process would require

- A. I to compete with II for a position on III.
- B. IV to bind with V for its activation.
- C. II to move to the intracellular environment and bind to V.
- D. I to bind with III but IV stays held to III.

Question 24

The influenza virus carries surface proteins called haemagglutinins that enable it to infect a host cell by penetrating the cell membrane. Some types of anti-viral drugs used to treat porcine influenza ('swine flu') resemble a protein that is the substrate of the haemagglutinin. These antiviral drugs can bind to the active site of haemagglutinin making it unable to bind to its substrate.

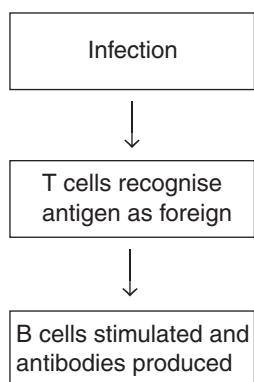
These drugs behave as

- A. retroviruses.
- B. enzymes.
- C. cofactors.
- D. competitive inhibitors.

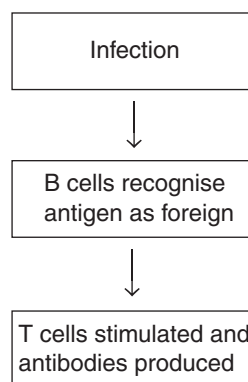
Question 25

A correct interaction between B and T lymphocytes during an immune response is shown in

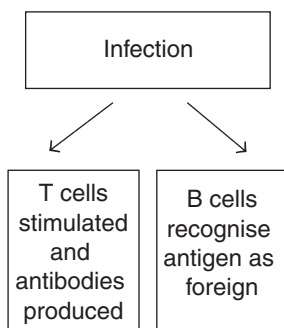
A.



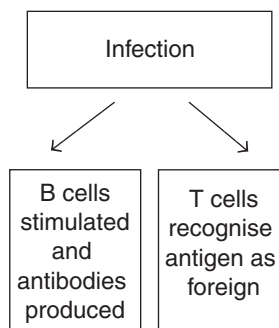
B.



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

Lactose is present in milk. It is broken down by lactase into glucose and galactose as shown in the equation below.



- a. Is this type of reaction catabolic or anabolic?

_____ 1 mark

- b. The molecular formula of galactose is $\text{C}_6\text{H}_{12}\text{O}_6$.

What is the molecular formula of lactose?

_____ 1 mark

Doctors use a lactose tolerance test to find out if a person is lactose intolerant. In this test, the person is given a solution of lactose to drink. Blood glucose concentration is then measured over the next two hours.

A lactose tolerance test was carried out on a healthy man who was lactose tolerant, and on a man who was lactose intolerant. The results for the first hour are shown in the table.

Time (mins)	Blood glucose concentration (mmol dm^{-3})	
	Healthy, lactose tolerant male	Lactose intolerant male
0	3.8	3.8
15	4.7	3.9
30	6.1	3.8
45	6.6	3.9
60	6.2	3.9

- c. i. What was the dependent variable in the experiment?

_____ 1 mark

- ii. State two factors that would need to be held constant so that the results can be directly compared.

 _____ 1 mark

- d. i.** Describe how the blood glucose concentration changed in the healthy man during the test.

1 mark

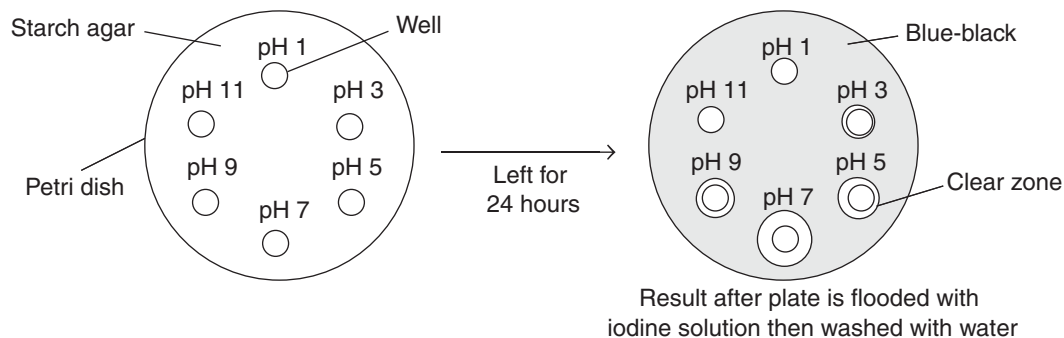
- ii.** Explain the results for the lactose intolerant man.

2 marks

Total 7 marks

Question 2

Amylase is an enzyme that breaks down starch. A student investigated the effect of pH on amylase activity by using a starch agar plate. Six circular wells were cut into the agar plate. Each well contained the same concentration and volume of amylase and a buffer solution of different pH. The agar plate was then left for 24 hours. The diagram shows the results.



- a. Describe how the student could have used these plates to compare the activity of the enzyme at different pH values.

2 marks

- b. The student concluded that pH 7 was optimal for amylase activity. This conclusion may not be valid. Explain why.

1 mark

- c. Using your knowledge of enzyme structure, explain the result obtained at pH 11.

2 marks

- d. Describe a control for this investigation. Explain why it would be necessary.

2 marks

Total 7 marks

Question 3

Pyruvate dehydrogenase complex deficiency (PDCD) is one of the most common human genetic disorders associated with abnormal mitochondrial metabolism. The Krebs cycle is a major biochemical process that derives energy from carbohydrates. Malfunction of this cycle deprives the body of energy.

- a.** PDCD is a genetic disorder.

Describe how a fault in the DNA could lead to a deficiency in pyruvate dehydrogenase.

2 marks

Pyruvate dehydrogenase converts pyruvate to acetyl-CoA (see below), which is one of the two essential substrates for the Krebs cycle and so the cycle cannot proceed.



- b. i.** How many ATP molecules are formed each time one revolution of the Krebs cycle is completed?

1 mark

- ii.** How does the mitochondrion use the NADH produced by the above reaction?

1 mark

An abnormal amount of lactic acid build-up results in symptoms ranging from severe lethargy to poor feeding habits.

- c. i.** Where is lactic acid produced within the cell?

1 mark

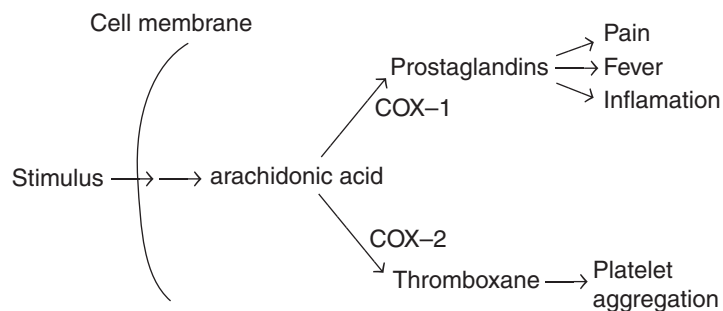
- ii.** Why would PDCD lead to severe lethargy?

2 marks

Total 7 marks

Question 4

Prostaglandins, like hormones, act as chemical messengers, but unlike hormones they do not move to other sites but rather work within the cells in which they are synthesised. The cellular pathways that lead to the production of prostaglandins and other associated responses to signalling are illustrated in the diagram below.



Their effects include involvement in the inflammatory response at the site of infection. Blood vessels become dilated and have increased permeability. This can result in swelling and a rise in temperature of the affected area, causing pain. There is also the possibility of blood clotting.

- a. Explain the survival advantage of the inflammatory response.

1 mark

Aspirin is a common drug used to reduce the synthesis of prostaglandin. Aspirin blocks an enzyme called cyclooxygenase, of which there are two types, COX-1 and COX-2.

- b. Draw a labelled diagram to illustrate how aspirin could act as a **non competitive** inhibitor of the COX-1 enzyme.

2 marks

- c. Describe three symptoms relieved as a result of taking aspirin.

1 mark

Total 4 marks

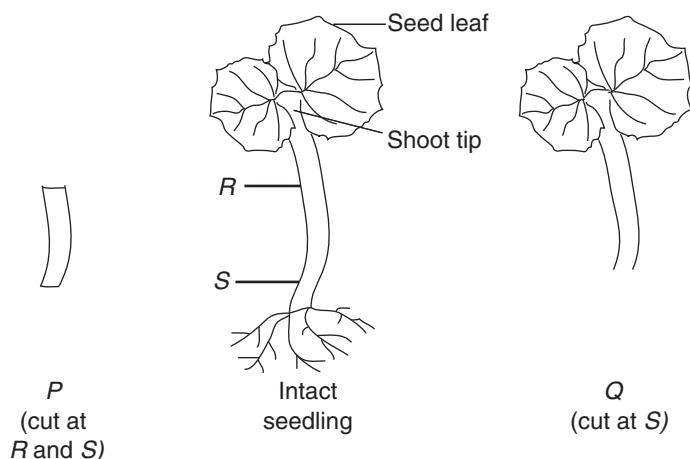
Question 5

IAA (indole acetic acid) is an auxin hormone that affects the growth of plants. It is produced in the tips of shoots and moves down the stem to the rest of the plant. A series of experiments was performed to investigate the effect of the IAA on the growth of cucumber seedlings.

- a. What effect does auxin normally have on plant cells?

1 mark

The diagram below shows the ways in which two groups of cucumber seedlings were cut before being used in an investigation.



The two types of cut seedlings, *P* and *Q*, were grown over a four-hour period in 1% sucrose solution containing different concentrations of IAAs.

Group of cut seedlings used	Concentration of IAA in growth medium (mg dm^{-3})	Mean increase in length (mm)	
		Grown in dark	Grown in light
<i>P</i>	0	1.2	0.8
<i>P</i>	6	3.9	5.2
<i>Q</i>	0	4.1	3.3
<i>Q</i>	6	4.9	5.7

- b. i. The cut seedlings were grown in sucrose solution rather than in distilled water. Give **one** reason why.

1 mark

- ii. When they were grown in the dark, the two groups of seedlings responded differently to the inclusion of IAA in their growth medium. Suggest **one** explanation for this different response.

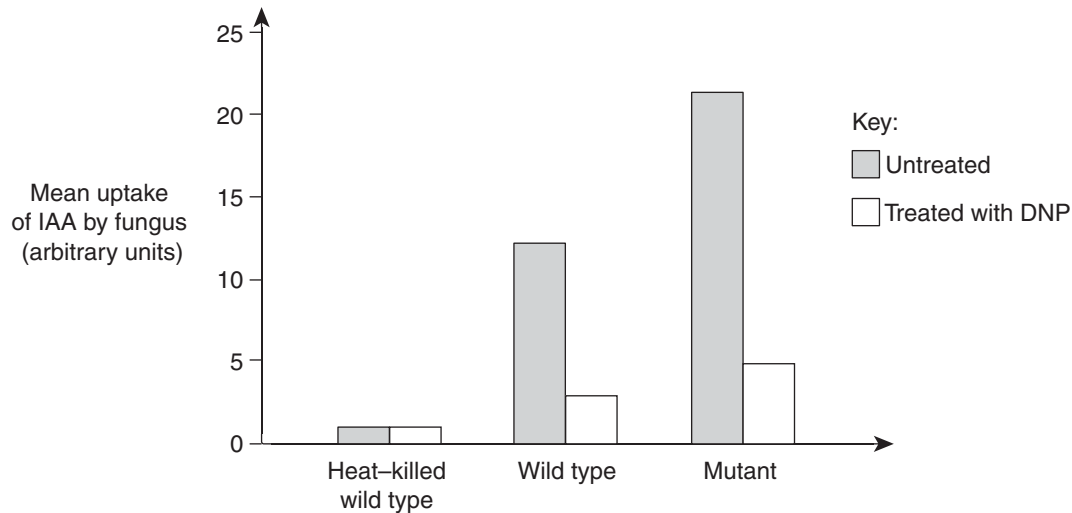
1 mark

- iii. Describe the effect of light on the growth of seedlings *P* and *Q*.

1 mark

A particular fungus (*Ustilago maydis*) is a disease-causing parasite of maize plants. Uptake of IAA from the host plant inhibits the ability of this parasitic fungus to invade and grow within maize plant tissue.

The uptake of IAA by *Ustilago* was investigated. Two strains of the fungus were used, the normal wild type and a mutant variety. The bar chart shows the results and also shows the effect of 2,4-dinitrophenol (DNP) on the uptake of IAA by this fungus. DNP is a drug that inhibits the functions of mitochondria.



- c. Using evidence from the information given above, and your own knowledge, respond to the following:

i. Explain how IAA is taken up by the cells of this fungus.

2 marks

ii. Suggest, giving a reason, how the mutation affected the cells of this fungus.

2 marks

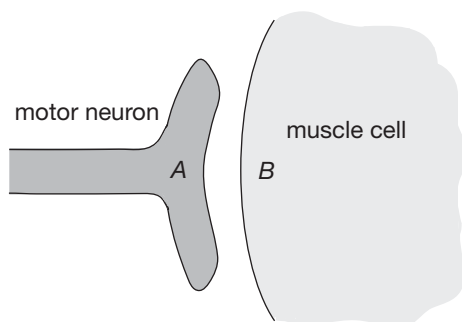
- d. Explain which variety of fungus is likely to be the more damaging pathogen of maize.

1 mark

Total 9 marks

Question 6

The venom of the Sydney funnel web spider, *Atrax robustus*, includes a protein, atraxotoxin, which affects nerve transmission. The main action of atraxotoxin occurs at the synapse between motor neurons and muscle cells. The venom causes the vesicles containing neurotransmitter molecules to empty and remain empty. The main effect is to block nerve impulses to the muscles, causing cramps and rigidity. In extreme cases, this can result in death due to respiratory or circulatory failure. Human beings and other primates are particularly sensitive to the venom, whereas toads, cats and rabbits are unaffected. A diagram of a neuro-muscular junction is shown in the figure below.



- a. i.** With reference to its effects, on which side of the neuro-muscular junction, *A* or *B* in the figure, would you expect atraxotoxin to act?

1 mark

- ii.** Explain why rabbits are not harmed by funnel web spider venom.

1 mark

Fortunately, a funnel web spider bite can be effectively treated using an appropriate antivenom. The antivenom is a highly purified rabbit IgG immunoglobulin (antibody). It is produced by injecting a rabbit with funnel web spider venom. The animal develops factors which counteract the spider venom. These factors are isolated from the animal's blood and used as the antivenom for treating humans.

- b. i.** Make a labelled diagram of an IgG immunoglobulin.

2 marks

- ii.** Suggest two ways in which this antibody could work to counteract funnel web spider venom in humans.

2 marks

- c.** Explain whether the immunity induced in a human by the antivenom is active or passive.

1 mark

- d.** Explain whether or not a person treated with antivenom on one occasion, then bitten again by a funnel web spider three years later, would still have an immunity against the venom.

2 marks

Total 9 marks

Question 7

About 50% of Australians have blood type O and 40% have blood type A. The other two blood types (AB and B) make up the remaining 10%. The A and B represent the presence (or absence) of glycoproteins on the surface of red blood cells that act as identity tags. Type O blood lacks these tags on the red blood cells. Type AB carries both these tags on the red blood cells.

- a. Using your understanding of membrane structure, how is this glycoprotein held in place on the surface of a red blood cell?

2 marks

Natural gut bacteria contain the same A and B proteins on their cell surface so the human immune system is exposed to both these proteins regardless of their blood type. As a result, different antibodies are formed which remain in the plasma for life.

- b. i. Why would the B protein on gut bacteria generate an immune response in an individual who is blood type A?

1 mark

- ii. Complete the table below by showing which antibodies are found in the plasma of humans with the 4 different blood types.

Blood type	Antibodies produced
A	
B	Antibodies against A
O	
AB	

2 marks

Occasionally these antibodies can pass through the placenta to an unborn child. This is of particular concern to mothers with an O blood type. This can lead to ABO haemolytic disease of the newborn (ABO HDN).

- c. Describe what would happen to the red blood cells of a blood type A newborn that develops ABO HDN.

2 marks

Total 7 marks

END OF QUESTION AND ANSWER BOOKLET