SECTION A - Multiple Choice Questions

Specific instructions for Section A

This section consists of 25 questions. You should attempt **all** questions.

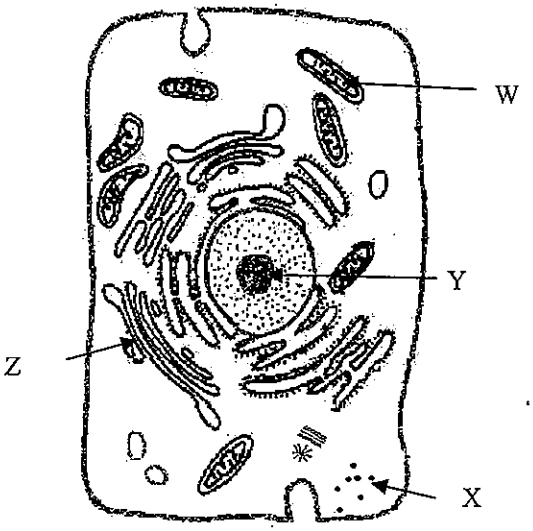
Each question has four possible correct answers. Only **one** answer for each question is correct. Select the answer that you believe is correct and indicate your choice on the Multiple Choice Answer Sheet by shading the letter that corresponds with your choice of the correct answer.

If you wish to change an answer, erase it and shade your new choice of letter.

Each question is worth **one** mark. **No** mark will be given if more than one answer is completed for any question. Marks will **not** be deducted for incorrect answers.

Question 1

The diagram below shows a typical cell.



It would be reasonable to state that:

A. structure labelled **Z** produces protein.
B. structure labelled **W** produces oxygen.
C. structures labelled **X** are produced in structure **Y**.
D. structure **W** is the site of glycolysis.

Question 2

The formula that represents a protein is:

A. $C_{256}H_{381}N_{65}O_{79}S_6$
B. $C_{57}H_{110}O_6$
C. $C_{27}H_{46}O$
D. $C_{10}H_{16}N_5O_{13}P_3$

Question 3

Glucose needs to enter cells for cellular respiration. The chemical that aids the movement of glucose across cell membranes is a:

A. protein
B. phospholipid
C. cholesterol
D. polysaccharide

Question 4

During aerobic respiration of glucose:

A. pyruvate enters the Krebs cycle and water is produced.
B. NADH enters the electron transport chain and water is produced.
C. NADH enters the electron transport chain and carbon dioxide is produced.
D. glucose enters the Krebs cycle and carbon dioxide and water are produced.

Question 5

A class of biology students extracted the photosynthetic pigments from ground spinach leaves, and measured the percentage absorption of different wavelengths of light of the extracted pigments. The following table shows the results.

Wavelength (nm)	Colour of light	% absorption
412	violet	49.8
457	blue	49.8
585	yellow	25.8
616	orange	32.1
533	green	17.8
674	red	41.0

From this data it could be concluded that:

A. spinach plants exposed to blue light will produce more oxygen than spinach plants exposed to red light.
B. spinach plants exposed to green light will produce more carbohydrates than spinach plants exposed to violet light.
C. all green plants would have the same absorption pattern as spinach.
D. the pigment chlorophyll absorbs mainly green light.

Question 6

The diagram below is a biomacromolecule found in living cells.

It is reasonable to state that:

A. X represents the primary structure of this molecule.
B. X is an alpha helix that is part of the DNA structure of this molecule.
C. X is a beta sheet that is part of the secondary structure of this molecule.
D. X is an alpha helix that is part of the secondary structure of this molecule.

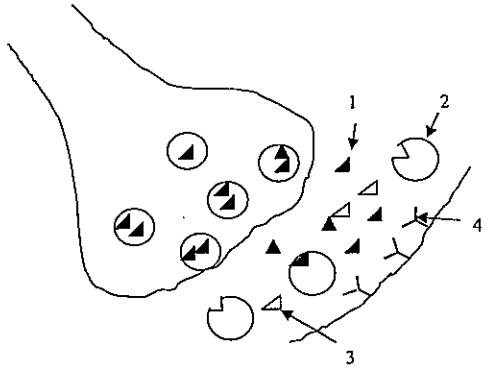
Question 7

Multiple sclerosis is a disease in which the individual produces antibodies against the myelin sheath of neurons. Based on this information it is reasonable to state that:

A. Multiple sclerosis is an example of passive immunity as there is no pathogen.
B. Multiple sclerosis is an example of an infectious disease.
C. a patient with multiple sclerosis would have faster reflexes.
D. a patient with multiple sclerosis would have slower reflexes.

The following information, including the diagram, applies to Questions 8 and 9.

The enzyme, acetylcholinesterase, is found in the synaptic gap. Organophosphorous pesticides irreversibly inhibit the active sites of acetylcholinesterase.



Question 8

The action of this pesticide would cause:

A. denaturation of receptor proteins on the post-synaptic membrane.
B. continued depolarisation of the post-synaptic membrane.
C. increased production of acetylcholine.
D. decreased production of acetylcholine.

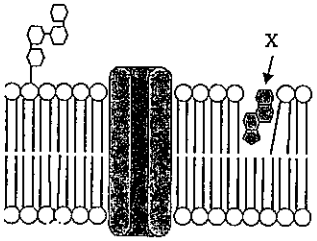
Question 9

The number in the diagram that corresponds to the organophosphate is:

A. 1
B. 2
C. 3
D. 4

Question 10

The diagram below shows a portion of the plasma membrane.



Molecule X is a:

A. glycolipid
B. cholesterol
C. transmembrane protein
D. phospholipid

Question 11

Many seeds such as beans need to be soaked before they will germinate when planted. The plant regulator that is removed on soaking is:

A. gibberellin
B. auxin
C. abscisic acid
D. ethylene (ethene)

Question 12

In the human respiratory system, the human influenza virus can attach to the tracheal cells and bronchi cells, but appear not to attach to the alveolar cells in the lungs. This is because tracheal and bronchi cells when compared to alveoli cells have:

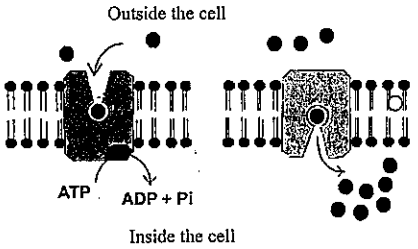
A. different DNA that codes for different protein receptors.
B. different functions so the same virus cannot attach.
C. different sites in the respiratory tract.
D. different receptor molecules on their cell membranes.

Question 13

Tadpoles undergo metamorphosis and change into frogs. This involves bone development of the limbs and breakdown and reabsorption of the tail. Both these responses are under the control of the amino acid hormone thyroxine. This information supports the fact that:

A. different tissues can respond to the same hormone in different ways.
B. the tail cells will have different receptors for thyroxine from the cells that lead to limb development.
C. thyroxine would freely enter these cells but bind to different parts of the DNA in the nucleus.
D. tadpoles fed thyroxine would develop into larger than normal frogs.

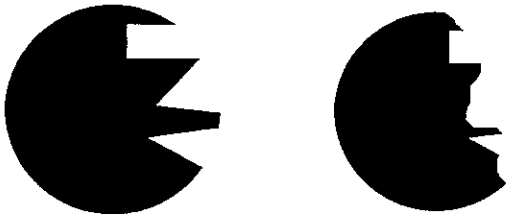
Question 14



The process shown in the diagram above could be:

A. carbon dioxide moving into the bloodstream from tissue cells.
B. oxygen crossing the cell membrane of the alveoli cells.
C. water moving into the cell by osmosis.
D. movement of sodium ions from a low concentration to a high concentration.

Question 15



Normal enzyme Altered enzyme

The diagram above is of a normal enzyme from a human cell and the same enzyme that has been altered. The alteration of the enzyme above could be due to:

A. exposing the enzyme to 37°C.
B. exposing the enzyme to heavy metals such as lead ions.
C. exposing the enzyme to 0°C.
D. increasing the substrate concentration so that the active site becomes distorted.

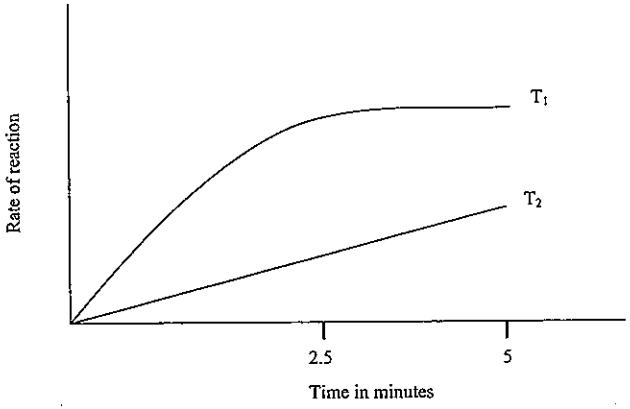
Question 16

The photosynthetic rate of plants drops when they do not receive enough water. This is due to the fact that:

A. water is a reactant in the light independent reaction.
B. water provides oxygen for the light dependent stage.
C. the stomata close, lowering CO_2 intake for the light independent stage.
D. hydrogen ions from water are not available for the light dependent stage.

Question 17

An experiment was conducted in which 0.5 mL of enzyme was added to 5 mL of substrate at 37°C. A second experiment was set up in which 0.5 mL of enzyme was added to 10 mL of substrate at 15°C. The graph below represents the action of the enzyme at the two different temperatures.



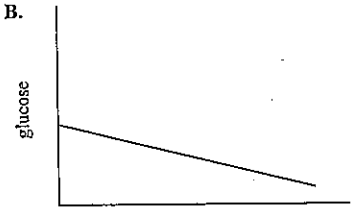
It would be reasonable to conclude that:
A. T_2 is 37°C and T_1 is 15°C.
B. the amount of product formed at T_2 will be twice that formed at T_1 at completion of the reaction.
C. the rate of reaction of both experiments continues to increase at the same rate between 0 and 2.5 minutes.
D. the graph for T_2 will level off after 5 minutes.

Question 18

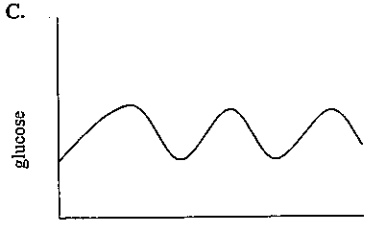
Blood sugar is a factor that needs to be controlled by means of homeostasis. The graph that best depicts the control of blood sugar over a 24 hour period would be:

A.

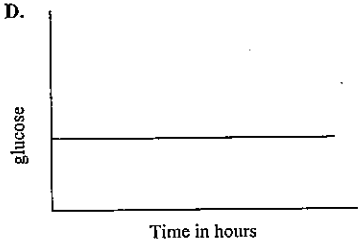
B.



C.



D.



Question 19

Mother rabbits show limited maternal care and only feed their pups for a few minutes once a day. It is important that the young maximise the time available to feed. The mother produces a volatile substance 2-methylbut-2enal, through her skin, and in her milk. This chemical causes an instant search and suckle response in the new born young. It is reasonable to conclude that:

A. this chemical is a paracrine molecule as it acts close to where it is formed.
B. a baby rabbit will only respond to this chemical if it has taken it in with the milk.
C. this chemical has a direct effect on the nervous system of the young rabbit.
D. this chemical is a pheromone and would have the same effect on all new born mammals.

Question 20

Myasthenia Gravis a disease that results in a weakness in skeletal muscles. This is due to the person forming antibodies against acetylcholine receptors on the postsynaptic membrane of muscle cells. It is reasonable to state that this is:

A. an autoimmune disease resulting in a lack of an action potential that would enable the muscle to contract.
B. an autoimmune disease resulting in continuous uncontrolled muscle contraction.
C. an infectious disease resulting in antibody formation as a response to antigens.
D. an autoimmune disease in which receptors identify the cells own antigens.

Question 21

Components that contribute to the inflammatory response are:

A. mast cells.
B. IgG antibodies.
C. T helper cells.
D. macrophages.

Question 22

The complement system consists of about 30 proteins circulating in the blood plasma. The complement system is activated when an antibody combines with an antigen to form a complex. The activation of one complement protein results in the activation of another complement protein and this activates yet another resulting in a cascade of reactions that result in the lysing of invading bacteria. Using this information it is reasonable to conclude that:

A. the complement cascade is an example of negative feedback.
B. the complement cascade is an example of positive feedback.
C. the complement cascade is an example of cell mediated immunity.
D. the complement cascade is part of the first line of defence.

Question 23

An example of a non-specific immune response against infection would be:

A. Natural killer cells binding to virus infected cells and destroying them.
B. plasma cells releasing antibodies that bind to antigens.
C. Cytotoxic T cells detecting foreign peptides displayed on virus infected cells and destroying them.
D. a macrophage presenting an antigen on its surface to a B cell.

Question 24

Immunotherapy is a treatment for some cancers involving stimulating the immune system to destroy tumours. This involves extracting the lymphocytes from the tumour, growing them in the laboratory and reintroducing them into the patient so that they can destroy the cancer cells. The lymphocytes best used for this approach would be:

A. cytotoxic T cells.
B. B cells.
C. macrophages.
D. suppressor T cells.

Question 25

Common gut bacteria have antigens that are similar or identical to antigens present on red blood cells that determine the blood groups of people. These bacterial antigens stimulate the formation of antibodies in individuals who do not have the particular antigens on their own red blood cells. The table below shows the antigens present on red blood cells and the associated blood groups.

Blood group	Antigens present on red blood cells
Group A	A
Group B	B
Group AB	AB
Group O	none

Using this information it can be stated that:

A. Group O individuals can only receive blood from a person who is group AB
B. Group O individuals can only donate blood to a person who is Group O.
C. Group AB individuals can only receive blood from a person who is Group O or Group AB.
D. Group A individuals can only donate blood to a person who is Group A or AB.

END OF SECTION A

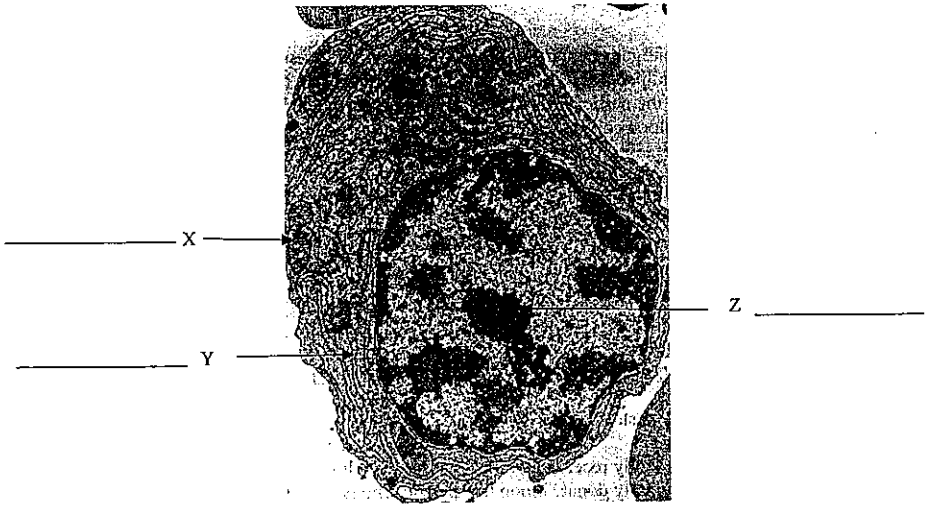
SECTION B - Short Answer Questions

Specific instructions for Section B

This section consists of 8 questions. There are 50 marks in total for this section.
Write your responses in the spaces provided. You should attempt **all** questions. Please write your responses in **blue or black ink.**

Question 1

The diagram below is an electron micrograph of a plasma cell.



a What is the function of plasma cells?

(1 mark)

b On the diagram above choose **two** structures out of X, Y and Z and name them on the diagram.

(2 marks)

c Suggest how each of the structures you have named above help the plasma cell to carry out the function named in **a** above.

Structure

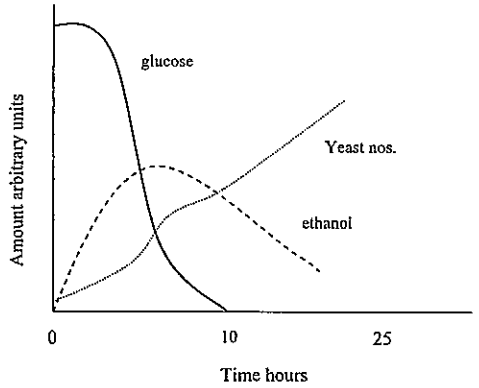
Structure

(2 marks)

Total 5 marks

Question 2

The yeast species *Saccharomyces cerevisiae* was grown in a culture medium provided with the substrate glucose. Measurements were made and plotted on the graph below.



a Name the process occurring in this culture media between 0 and 10 hours.

(1 mark)

b Name another product that would be produced during this time.

(1 mark)

c Where in the yeast cell would this process take place?

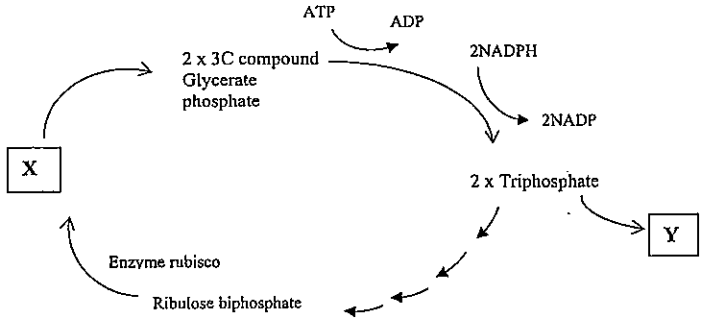
(1 mark)

d Suggest why the ethanol level declines and the yeast numbers go up.

(2 marks)

Total 5 marks

Question 3.
Photosynthesis consists of two main stages. The diagram below shows one of those stages.



a What term is given to the stage depicted in the diagram?

(1 mark)

b Name the input substance labelled **X**.

(1 mark)

c Name the output substance represented by **Y**.

(1 mark)

The enzyme rubisco accounts for 50% of the mass of the chloroplast.

d Give a possible reason for this observation.

(1 mark)

e Where in the chloroplast does this stage take place?

(1 mark)

The rate of photosynthesis can be measured experimentally by measuring the net uptake of carbon dioxide, in mg of CO_2/g of dry weight/hour.

f Would this be a measure of the true rate of photosynthesis? Explain your answer.

(2 marks)

Total 7 marks

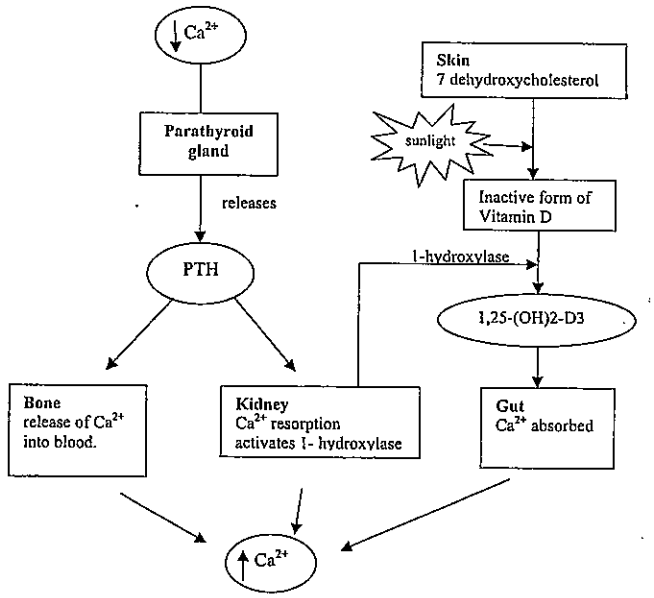
Question 4

Blood calcium ions (Ca^{2+}) need to be maintained between 2.2 and 2.5 mmol/L. This must be strictly controlled as Ca^{2+} ions are needed for efficient nerve function. The two most important hormones for maintaining calcium levels in the body are parathyroid hormone (PTH) and 1,25-(OH)2D3,which is the active form of vitamin D. Inactive vitamin D is formed under the skin in sunlight. The system is controlled by negative feedback.

PTH

- stimulates the release of calcium from bones.
- decreases the amount of calcium in the urine by stimulating calcium reabsorption in the kidney tubules.
- activates the enzyme 1-hydroxylase in the kidney that converts the inactive form of vitamin D to the active form 1,25-(OH)2D3, which results in calcium being absorbed from the gut.

The diagram below outlines calcium homeostasis.



a What is the stimulus for the release of PTH?

(1 mark)

b What is a negative feedback system?

(1 mark)

c Mark on the diagram a negative feedback arrow. (1 mark)

It is thought that 1,25-(OH)2D3 may bring about a lowering of PTH.

d Suggest how this would help control calcium homeostasis.

(1 mark)

In some kidney diseases the production of the enzyme 1-hydroxylase is reduced.

e Suggest a consequence of this situation for a person with this type of kidney disease.

(2 marks)

Total 6 marks

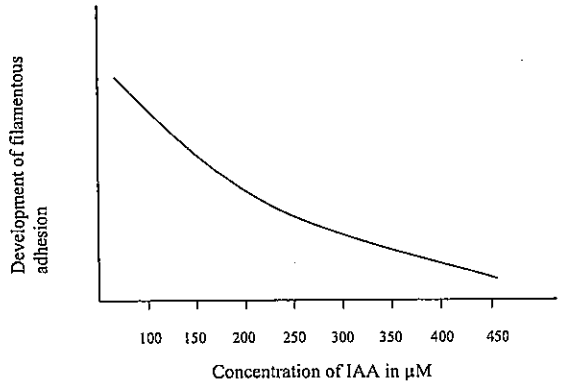
Question 5

Plants are susceptible to invasion by pathogens such as fungi. When fungal spores arrive on a plant they must first develop into a filamentous form that will adhere to the plant and enable invasion. The hormone indole-3-acetic acid or IAA, a type of auxin, stimulates yeasts to form filaments. Yeast cells take up IAA from their surroundings and also produce some IAA themselves.

a What function does IAA (auxin) have in a plant?

(1 mark)

Scientists researching the effect of IAA on the growth of yeast obtained the following results.



b What is the relationship between the concentration of IAA and the degree of filamentation in the yeast?

(1 mark)

c Considering these results:

(i) How does IAA help the yeast as a pathogen?

(1 mark)

(ii) How does IAA help the plant prevent infection?

(1 mark)

Fungal cells that cause disease in humans such as nail and skin infections also need to undergo filamentation before they can invade the tissues.

D A biochemistry student suggested using a high concentration of IAA in a spray to prevent fungal infections. Discuss the implications of such a spray.

(1 mark)

Total 5 marks

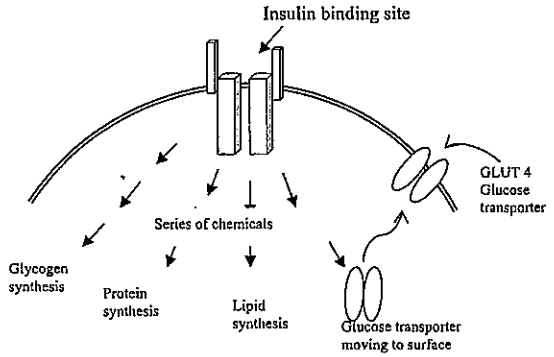
Question 6

Blood glucose levels are controlled by homeostasis. Insulin, a protein hormone produced by the pancreas, enables glucose to be maintained within a normal range of 3.6 to 6.8 mmol per L.

a Why does glucose need to be maintained within this narrow range?

(1 mark)

The diagram below shows the result of insulin binding to receptors on the cell surface. A series of chemical reactions are shown below also including glucose transporters moving to the cell surface to enable glucose to enter the cell.



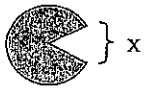
b Why does insulin bind to receptors on the plasma membrane and not to receptors inside the cell?

(1 mark)

c What name is given to the series of chemicals that result from the binding of insulin to the receptor site?

(1 mark)

Insulin needs to be broken down. An enzyme responsible for the breakdown of insulin is IDE (Insulin-degrading protein enzyme). Type II Diabetes is a disease that results in high blood glucose levels. Insulin is produced in Type II diabetes but it does not act effectively. One theory is that the person with Type II diabetes has an overabundance of IDE. The diagram below shows the shape of IDE.



The part labelled **X** opens and closes to enclose small proteins such as insulin. The enzyme then slices these proteins into tiny pieces. When **X** is fully open the enzyme is 30 to 40 times more active.

d What name is given to area **X**?

(1 mark)

This same enzyme (IDE) is responsible for the breakdown of β amyloid protein, the accumulation of which in the brain, is thought to be responsible for Alzheimer's disease. It has been suggested that because Alzheimer's disease is increasing in the population, it could be linked to a fast-food high sugar diet.

e Suggest how medical scientists may have come to this conclusion.

(2 marks)

Scientists are considering using rational drug design to lower the action of IDE in the case of Type II diabetes.

f What is rational drug design?

(1 mark)

g How might scientists use rational drug design to lower the action of IDE?

(1 mark)

Total 8 marks

Question 7

One type of classification of human blood type is Rhesus positive or Rhesus negative. Individuals who are Rhesus positive (Rh^+) have a transmembrane protein present on the surface of their red blood cells, whereas individuals who are Rhesus negative (Rh^-) do not have this protein. The Rhesus factor becomes significant when a woman who is Rh^- becomes pregnant with a child who is Rh^+. During the birth, some red blood cells from the baby may pass into the bloodstream of the mother.

a Suggest any likely result from this situation.

(1 mark)

b If this is the woman's first baby the situation is not as critical as it would be for subsequent pregnancies. Explain why.

(2 marks)

If a woman is known to be Rh^- and her baby is Rh^+ she is immediately injected with anti-Rh within 72 hours of giving birth.

c What type of substance would anti-Rh be?

(1 mark)

d What type of immunity is the mother's reaction to the injection? Explain your answer.

(1 mark)

e Why must this injection be given within 72 hours?

(2 marks)

Total 7 marks

Question 8

DNA is made up of nitrogen bases.

a Name the nitrogen bases that make up the DNA molecule.

(2 marks)

Cystic fibrosis (CF) is a genetic disease due to a fault in the cystic fibrosis trans-membrane conductor regulator (CFTR) protein in the cell membrane. This protein is responsible for the transport of chloride ions across the cell membrane.

b Why do chloride ions require a trans-membrane protein in order to enter or leave the cell?

(1 mark)

The tables below show normal CFTR and one mutation that is involved in cases of cystic fibrosis.

Normal CFTR

Triplet number	506	507	508	509	510
DNA bases	ATC	ATC	TTT	GGT	GTT
Amino acid	leucine	leucine	phenylalanine	Glycine	Valine

Cystic Fibrosis CFTR

Triplet number	506	507	508	509
DNA bases	ATC	ATT	GGT	GTT
Amino acid	leucine	leucine	Glycine	Valine

c What change has occurred in the DNA sequence that resulted in Cystic fibrosis?

(1 mark)

d How has this change altered the CFTR protein?

(1 mark)

e Explain how this change may have adversely affected the function of the CFTR protein.

(2 marks)

Total 7 marks

END OF EXAMINATION

TEACHERS, PLEASE NOTE:

In marking the Exam, teachers should keep in mind that the language used in the suggested answers is sometimes more sophisticated than a student would offer since these answers are written for teachers' information in their correction of the Exam.

The answers suggested here might not be the only correct responses possible. Teachers must use their professional judgement in awarding marks for other answers offered. However, in accordance with the VCAA practice, students who give a correct response, and then offer a contradictory incorrect response within the same part of the question, should not be awarded any marks for the correct part of the response. Also in accordance with the VCAA practice, no half marks should be given.

SECTION A - MULTIPLE CHOICE QUESTIONS (1 mark each: 25 marks)

1	C	16	C
2	A	17	B
3	A	18	C
4	B	19	C
5	A	20	A
6	D	21	A
7	D	22	B
8	B	23	A
9	C	24	A
10	B	25	D
11	C		
12	D		
13	A		
14	D		
15	B		

SECTION B - WRITTEN RESPONSES

Question 1

a The plasma cell produces antibodies. *1 mark*

b Any two of the following (1 mark each)
X is a mitochondrion
Y is the rough endoplasmic reticulum
Z is the nucleolus *2 marks*

c (Connection must be made between the structure and the function of this cell in the formation of antibodies)
Any two of the following (1 mark each)
X provides the energy (ATP) for the synthesis reaction of forming protein (antibodies).
The nucleolus is responsible for the formation of ribosomes that are the site of protein (antibody) formation.
Rough endoplasmic reticulum is responsible for the modification of protein (antibodies). *2 marks*

Total Question 1: 5 marks

Question 2

a Anaerobic respiration. *1 mark*

b Carbon dioxide. *1 mark*

c In the cytoplasm of the cell. *1 mark*

d The yeast will start to breakdown the ethanol as an energy source (1) and this production of energy will enable the yeast cells to reproduce and increase in numbers (1). *2 marks*

Total Question 2: 5 marks

Question 3

a Light independent stage **OR** the Calvin cycle **OR** carbon fixation. *1 mark*

b Carbon dioxide. *1 mark*

c Glucose. *1 mark*

d The enzyme needs to be there in high concentrations so that the rate of the reaction will be fast enough, therefore the enzyme accounts for 50% of the mass of the chloroplast. *1 mark*

e The stroma. *1 mark*

f Some of the CO_2 used in photosynthesis is produced in respiration (1) therefore a measure of the true rate of photosynthesis is greater than the rate of CO_2 used (1). *2 marks*

Total Question 3: 7 marks

Question 4

a The decrease in concentration of calcium ions in the bloodstream. *1 mark*

b A negative feedback system is one in which the response to a stimulus acts to reverse the direction of the stimulus. *1 mark*

c The line will go from the Ca^{2+} up to the parathyroid gland. *1 mark*

d Once $1,25(OH)_2D3$ has been produced by the activity of PTH and calcium can be absorbed from the gut, more absorption may increase the concentration of calcium therefore the feedback of $1,25(OH)_2D3$ to lower PTH would help balance calcium. *1 mark*

e If the production of 1-hydroxylase is reduced there would be less conversion of the inactive form of vitamin D to the active form resulting in less absorption of calcium from the gut (1). The consequence for the person would be more absorption of calcium from the bones resulting in brittle bones (1). *2 marks*

Total Question 4: 6 marks

Question 5

a Auxin stimulates growth of shoots towards the light. *1 mark*

b At low concentration of IAA, development of filamentation and adhesion is high, whereas at high concentrations development of filamentation is inhibited. *1 mark*

c i The presence of IAA in low concentrations enables the yeast to become filamentous and therefore penetrate the plant becoming a pathogen that causes disease.

ii The high concentration of IAA produced by the plant inhibits the yeast from forming filaments and being able to penetrate the plant, therefore helps protect the plant from infection. *1+1 mark*

d A high concentration of IAA could prevent the yeast from forming filaments and as filamentation is needed for invasion, prevent infection by the yeast. *1 mark*

Total Question 5: 5 marks

Question 6

a	*Glucose needs to be present in a high enough concentration to support respiration of cells but not too high so as to cause water to leave the cells by osmosis.*	*1 mark*
b	*As insulin is a protein it is not lipid soluble so is not able to pass through the lipid bilayer of the cell membrane and so it binds to receptors on the surface.*	*1 mark*
c	*Secondary messengers.*	*1 mark*
d	*Active site of the enzyme.*	*1 mark*
e	*When there is a high sugar diet the insulin levels are high (1) and IDE will spend more time breaking down insulin and will not be as available for clearing the β amyloid protein (1) therefore there is a higher chance of β amyloid protein forming plaques in the brain tissue leading to Alzheimer's disease.*	*2 marks*
f	*Rational drug design is the design and construction of a drug to fit the active site of a molecule so that the natural action of the molecule cannot occur.*	*1 mark*
g	*Rational drug design could work to design small molecules that would act to maintain the active site of IDE permanently open* ***OR*** *block the active site of the enzyme IDE.*	*1 mark*
	Total Question 6:	***8 marks***

Question 7

a	*The mother would form antibodies against the Rh protein on the baby's red blood cells.*	*1 mark*
b	*For the first Rh^+ baby the mother usually forms antibodies only after exposure to the Rh^+ red blood cells at the birth, therefore that first baby will not be affected (1). However after this first birth and exposure she will form Rh antibodies that will be able to pass across the placenta and destroy the red blood cells of later Rh^+ babies (1).*	*2 marks*
c	*This would be antibodies against the Rh protein.*	*1 mark*
d	*Passive immunity as the antibodies are formed in another individual.*	*1 mark*
e	*By injecting the mother within 72 hours this lowers the chance of the mother forming antibodies against the Rh protein (1) and also prevents her from forming B memory cells that would form Rh antibodies in the future (1).*	*2 marks*
	Total Question 7:	***7 marks***

Question 8

a	*Adenine, guanine, thymine, cytosine. (All correct for 2 marks)*	*2 marks*
b	*Chloride ions are charged particles and are therefore hydrophilic and so are unable to pass through the hydrophobic cell membrane.*	*1 mark*
c	*TCTT has been removed.*	*1 mark*
d	*It has resulted in the deletion of the amino acid phenylalanine.*	*1 mark*
e	*This change in the primary structure of the peptide chain will alter the way the peptide chain folds into a secondary and tertiary structure (1). This inability to form the proper three dimensional structure will mean that it will not be able to act as a channel for the chloride ion to pass across the cell membrane (1).*	*2 marks*
	Total Question 8:	***7 marks***

Total Section B: ***50 marks***
Total examination: ***75 marks***

END OF SUGGESTED SOLUTIONS