Neap:

Trial Examination 2012

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 20 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.

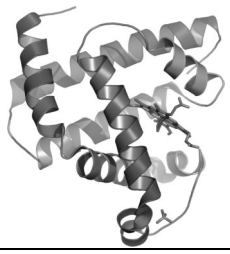
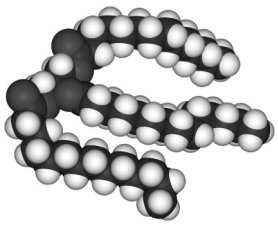
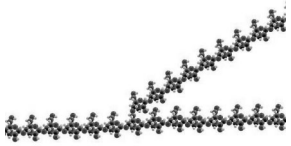
Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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.

Questions 1 and 2 refer to the following information.

biomolecule 1	biomolecule 2
	
biomolecule 3	biomolecule 4
 modified from original uploaded by Richard Wheeler (Zephyris) http://en.wikipedia.org/wiki/File:A-DNA,_B-DNA_and_Z-DNA.png	

Question 1

The biomolecules that are polymers include

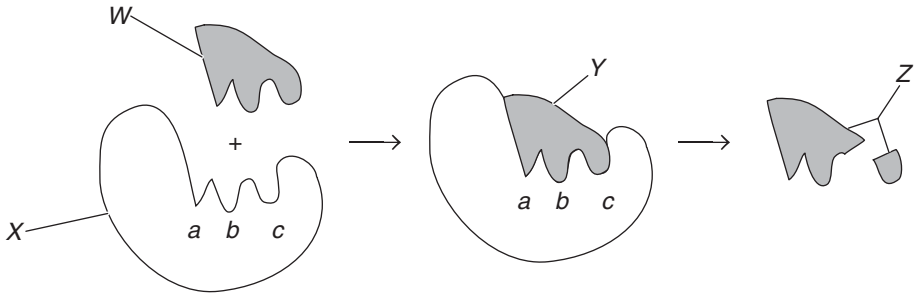
A. biomolecule 3 only.
B. biomolecule 2 and 3.
C. biomolecule 1 and 4 only.
D. biomolecule 1, 3 and 4.

Question 2

When each of the biomolecules is synthesised, the reaction could be referred to as

A. an anabolic hydrolysis reaction.
B. a catabolic hydrolysis.
C. an anabolic condensation reaction.
D. a catabolic condensation.

Questions 3 and 4 refer to the following diagram of a chemical reaction within a cell.



Question 3

Chemical *W* is known as

A. a product.

B. a substrate.

C. an enzyme.

D. a non-competitive inhibitor.

Question 4

Areas *a*, *b* and *c* are part of

A. a receptor.

B. a cofactor.

C. the quaternary structure of the molecule.

D. the active site.

Question 5

What aspect of their structure makes carbohydrates well suited for storing energy?

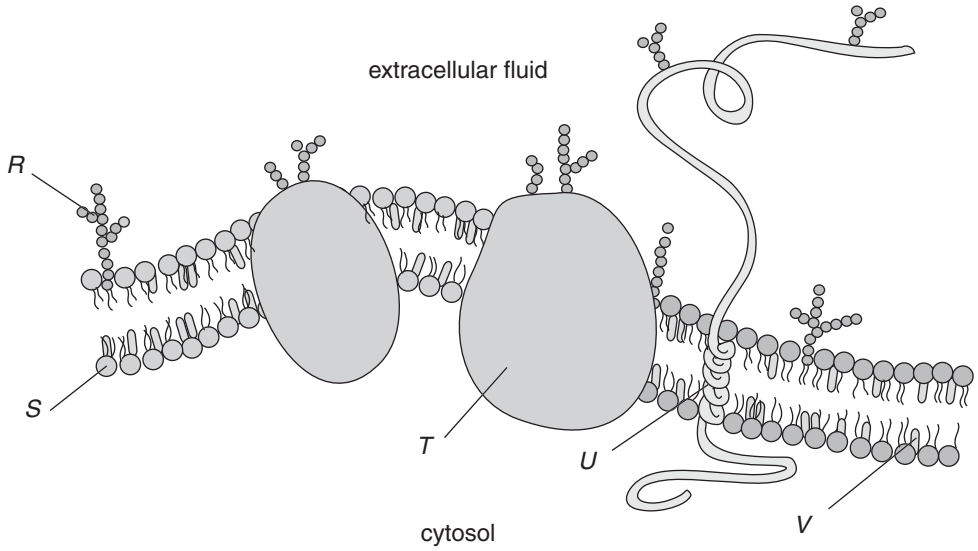
A. Because carbohydrates are always polymers, they can form long, compact chains of atoms, which store energy more efficiently than monomers.

B. The large number of carbon-hydrogen bonds in a carbohydrate releases a large amount of energy when oxidized.

C. Large carbohydrate molecules are broken down into ATP molecules, the 'energy currency' of the cell.

D. The long chains of fatty acids which make up carbohydrates are saturated, thus every carbon atom has high-energy bonds with at least two hydrogen atoms.

Questions 6 and 7 refer to the following diagram of a plasma membrane from a typical animal cell. Labels R *to* V *represent components of the membrane.*



Question 6

The components that best represent glycoproteins include

A. *R* and *T.*
B. *R* and *U.*
C. *S* and *V.*
D. *T* and *U.*

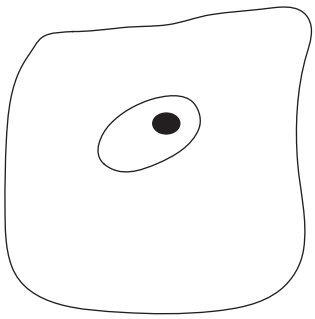
Question 7

If the extracellular environment of a cell was hypertonic, the most likely outcome would be that

A. water would move into the cell.
B. water would move out of the cell.
C. structure *V* would dissolve in the water.
D. structure *S* would become less stable.

Question 8

The diagram below shows a typical human cheek cell.



The statement that most closely reflects the proteome and/or the genome of this cell is that

A. The proteome of this cell is the same as the genome.
B. The genome for this cell would be different from that of any other cell from the same human.
C. The proteome of this cell would be different from that of other types of cells in the same human.
D. The proteome is clearly visible within the cell.

Question 9

The kangaroo rat is a small mammal that is adapted for life in the desert and to conserve water. It feeds mainly on seeds. The equations below summarise the oxidation of glucose and of palmitic acid (a typical fatty acid) during respiration in the rat's cells. Both these substances are formed when the rat digests seeds.

Glucose: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + (36 - 38 \text{ATP per mole})$

Palmitic acid: $C_{15}H_{31}COOH + 23O_2 \rightarrow 16CO_2 + 16H_2O + (130 \text{ATP per mole})$

Based on this information, which of the following statements is most reasonable?

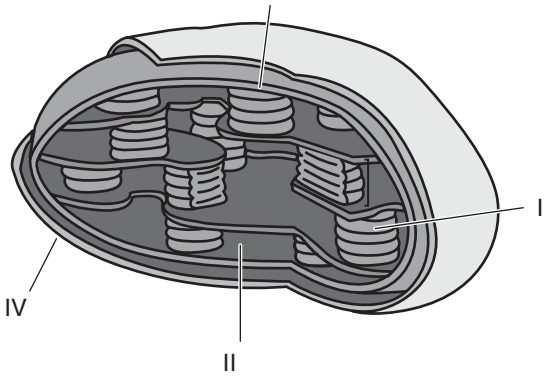
A. The rat would gain more benefit from respiring glucose than palmitic acid, because this reaction requires less oxygen.

B. The rat would gain an advantage from respiring palmitic acid rather than glucose, because this reaction releases more water.

C. The same metabolic pathway would break down both reactants in the same way.

D. Both reactions are endergonic and catabolic.

Question 10



Identify I, II, III and IV in the above diagram.

A. I-Thylakoid; II-Stroma; III-Inner membrane; IV-Outer membrane

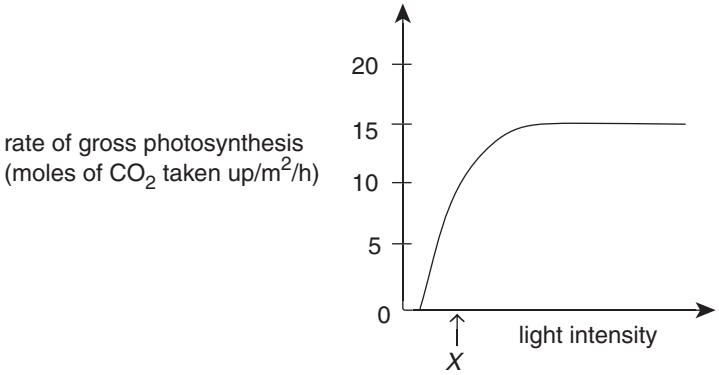
B. I-Granum; II-Chlorophyll; III-Inner membrane; IV-Outer membrane

C. I-Cristae; II-Matrix; III-Inner membrane; IV-Outer membrane

D. I-Granum; II-Stroma; III-Outer membrane; IV-Inner membrane

Question 11

The graph below illustrates a light response curve for a plant carrying out photosynthesis.



The rate of respiration in the leaves of the plant is 15 moles of CO_2 produced per m^2 per hour.

What is the rate of net gas exchange when the gross rate of photosynthesis is that produced by the light intensity indicated by the symbol *X*?

A. 5 moles of CO_2 given off per m^2 per hour.

B. 0 moles of CO_2 taken up and given off per m^2 per hour.

C. 5 moles of CO_2 taken up per m^2 per hour.

D. 10 moles of CO_2 taken up per m^2 per hour.

Question 12

Why does the photosynthetic production of glucose in plants rely on the formation of ATP and NADPH in the light-dependent reactions?

A. ATP and NADPH are required for chlorophyll to function properly.

B. The CO_2 absorbed from the air must be combined endergonically with hydrogen from NADPH to form glucose.

C. Active uptake of CO_2 from the air into the leaf requires ATP; the CO_2 is then combined with hydrogen from NADPH to form glucose.

D. ATP and NADPH are important intermediates in the Calvin cycle.

Question 13

Which of the following statements about feedback systems in mammals is correct?

A. Positive feedback systems always result in harm.

B. Negative feedback increases the intensity of the original stimulus.

C. Negative feedback systems operate to prevent the internal environment from changing beyond tolerable limits.

D. Blood glucose concentration is regulated by a positive feedback system.

Question 14

It is correct to say that hormones

A. are only involved in coordinating growth, development and reproduction.

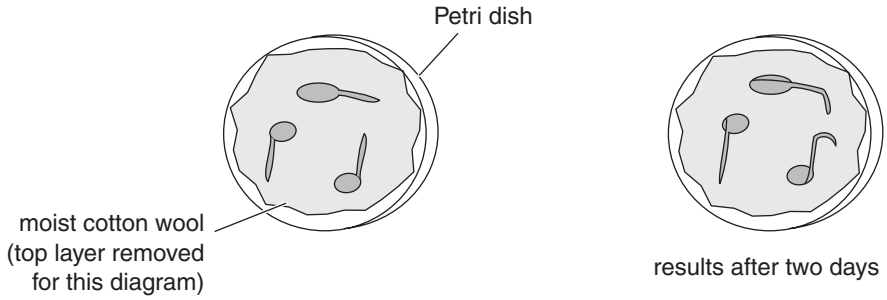
B. are intercellular chemical signals that only affect target cells located far away from the tissue secreting the hormone.

C. are only secreted by endocrine glands.

D. only exert their effects by binding to specific receptors on the cell membrane or in the cytosol or nucleus of target cells.

Question 15

The diagram below is of an experiment investigating root growth of germinating seeds.



The resultant root growth as observed after two days is due to

A. phototropism.

B. unequal distribution of auxin.

C. negative geotropism.

D. abscisic acid.

Question 16

The following events occur during signal transduction brought about by a steroid hormone.

1. The hormone binds to an intracellular receptor.
2. The specific proteins produced bring about the cellular response.
3. Messenger RNA is translated which leads to the synthesis of specific proteins.
4. The hormone diffuses into the cell through the phospholipid bilayer of the cell membrane.
5. Messenger RNA is transcribed.
6. The hormone-receptor complex binds to DNA in the nucleus.

The correct sequence for these events is

A. 1, 4, 6, 5, 3, 2

B. 4, 1, 6, 5, 3, 2

C. 1, 4, 6, 3, 5, 2

D. 4, 1, 3, 6, 5, 2

Question 17

A single signalling molecule can cause the production, inside a cell, of several molecules capable of activating previously inactive enzymes. Each of these activated enzymes can activate thousands of other inactive enzyme molecules, and each of these can then catalyse thousands of reactions.

This process is called

A. the cascade effect.
B. the second messenger effect.
C. positive feedback.
D. homeostasis.

Question 18

Which of the following mechanisms would assist in preventing the entry of pathogens through the human eye, mouth and airway?

A. the secretion of slightly acidic fluids onto the surfaces of these organs
B. a covering of hair
C. mucous membranes covering the surfaces of these organs
D. the secretion of lysozyme onto the surfaces of these organs

Question 19

The complement system is a group of

A. proteins involved in the innate immune reponse.
B. proteins secreted by 'helper' T cells.
C. proteins that act independently to attack microbial pathogens.
D. antiviral proteins that includes interferons.

Question 20

Which of the following observations best shows the effect of memory cells in the acquired immune response?

A. the role of MHC proteins in helping cytotoxic T-cells distinguish 'self' from 'non-self' cells
B. the ability of a specific lymphocyte to multiply into a clone when it encounters a specific 'non-self' antigen
C. the ability of people who had recovered from smallpox to care for those newly affected by the disease without contracting smallpox again
D. the ability of some strains of the typhoid-causing bacterium to cause worse symptoms of the disease than others

Question 21

Antihistamines are contained in drugs taken by people who suffer from allergies such as hay fever. These chemicals act to oppose the effects of histamines secreted by mast cells.

The role of histamines is to promote

A. the dilation of blood vessels during inflammation.
B. phagocytosis by neutrophils.
C. the multiplication of clones of lymphocytes.
D. the presentation of antigens to 'naive' lymphocytes by macrophages.

Question 22

Non-vaccinated school-age children are often protected from vaccine-preventable diseases such as diphtheria, measles, and polio because

A. they are still protected by maternal antibodies.
B. the majority of children have been immunised against these diseases (herd immunity).
C. these diseases have been eradicated.
D. such diseases exist only in underdeveloped countries.

Question 23

Which type of T cell lyses cells that have been infected with viruses?

A. inducer T cells
B. helper T cells
C. cytotoxic T cells
D. suppressor T cells

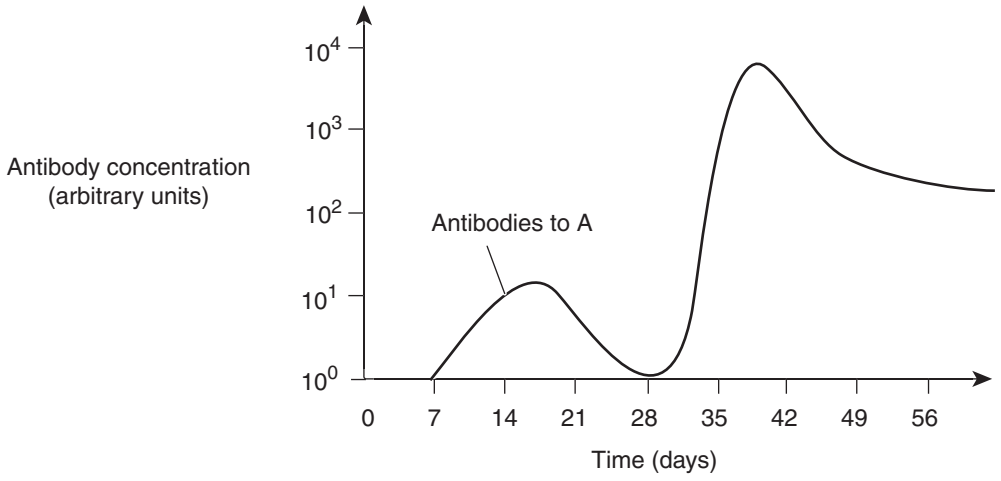
Question 24

The immunity acquired as a result of exposure to an antigen in a vaccine is

A. artificial active immunity.
B. artificial passive immunity.
C. auto-immunity.
D. natural active immunity.

Question 25

The graph below shows the change in blood serum concentration of antibodies produced by a rat in response to infection by a specific antigen.



It is correct to state that:

A. infection by the antigen took place on day 6, followed by an infection by a different antigen on day 29.
B. it took the rat's adaptive immune system six days to produce detectable quantities of antibodies in response to the initial infection.
C. antibodies were produced in stages in response to infection by the antigen, each stage producing more antibodies than the last as the antibodies were used up.
D. the peak in antibody production on day 38 was brought about by an increase in the number of memory cells between days 29 and 37.

SECTION B: SHORT-ANSWER QUESTIONS

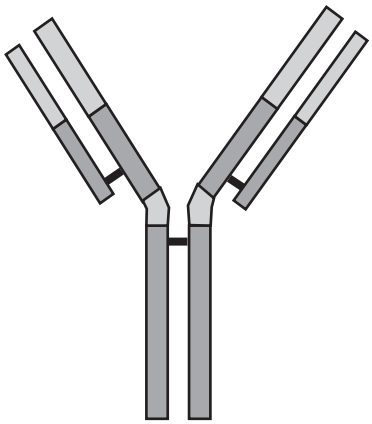
Instructions for Section B

Answer this section in **pen**.

Answer all questions in the spaces provided.

Question 1

During an immune response, B cells secrete antibody molecules. The diagram below is of an antibody molecule.



a. **i.** Indicate the position(s) on the antibody to which the antigen(s) bind.

ii. Label the disulfide bonds in the molecule and explain their importance in the quaternary structure of protein molecules, such as antibodies.

_____

_____

_____

1 + 2 = 3 marks

b. Describe how antibodies provide protection against pathogens, such as bacteria.

_____

_____

_____

_____

_____

2 marks

c. Other proteins are found in plasma membranes.

Describe the role one plasma membrane could carry out.

_____

_____

_____

1 mark

Total 6 marks

Question 2

Diastase is a bacterial enzyme that catalyses the hydrolysis of starch to maltose. An investigation was conducted to test the effect of pH on the activity of diastase.

Eight test-tubes were set up, each containing 2 mL of a buffer solution of specific pH and 2 mL of 1% diastase solution. The test-tubes were heated to 37°C in a water-bath. When this temperature had been reached, 5 mL of a 1% starch solution (also heated to 37°C) was added to each test-tube.

Immediately after adding the starch, a single drop was taken from each test-tube and tested for the presence of starch by adding it to a drop of iodine solution. A blue-black colour indicated the presence of starch. Drops were then taken every 2 minutes for 20 minutes and tested in the same way.

pH	Time/min										
	0	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
2.0	●	●	●	●	●	●	●	●	●	○	○
3.0	●	●	●	●	●	●	●	○	○	○	○
4.0	●	●	●	●	○	○	○	○	○	○	○
5.0	●	●	●	○	○	○	○	○	○	○	○
6.0	●	○	○	○	○	○	○	○	○	○	○
7.0	●	●	○	○	○	○	○	○	○	○	○
8.0	●	●	●	●	●	●	●	○	○	○	○
9.0	●	●	●	●	●	●	●	●	●	○	○

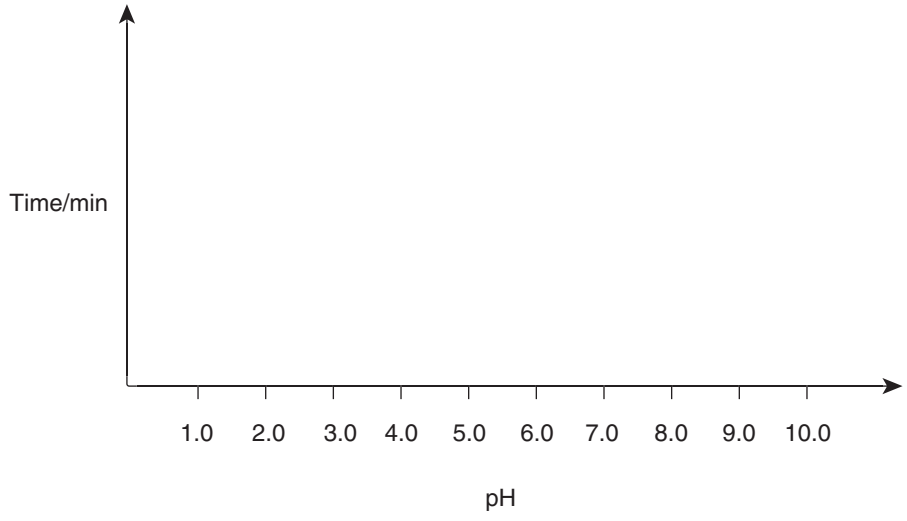
Key:
● = starch present
○ = starch not present

a. What is meant by 'the hydrolysis of starch'?

_____

1 mark

b. Use the axes below to sketch a graph to show the effect of pH on the time taken for complete hydrolysis of the starch sample by diastase.



2 marks

c. With reference to these results, describe **and** explain the effect of pH on the rate of hydrolysis of starch by diastase.

_____

_____

_____

_____

_____

2 marks
Total 5 marks

Question 3

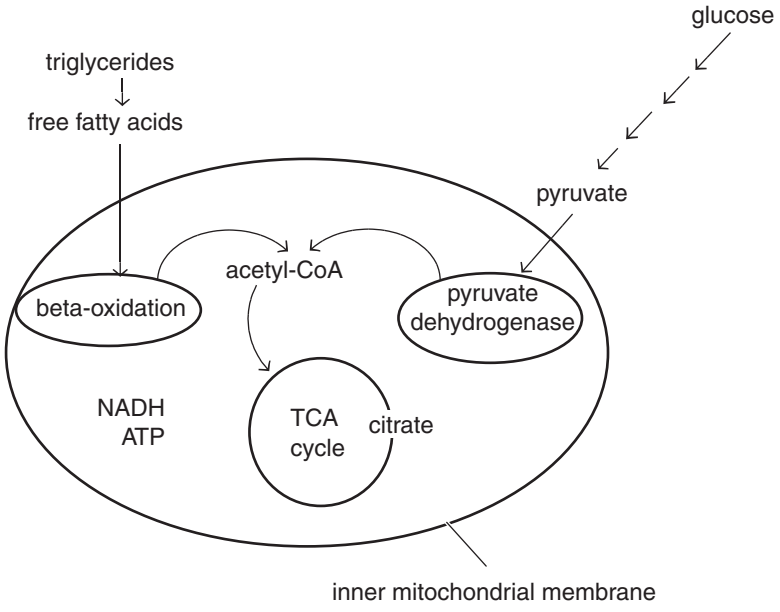
Fats are stored in adipose tissue. These stored fat molecules (triglycerides) are synthesised in the body from the products of fat digestion, which include fatty acids.

a. What other product is formed when triglycerides are broken down?

_____

1 mark

When needed as an energy source, the fat reserves are mobilised, moved out of adipose tissue, and broken down in the liver by the process of lipolysis. Free fatty acids are then circulated around the body to be integrated into the cellular respiration pathway within body cells, as illustrated in the diagram below. Fatty acids are changed in a series of reactions, called beta-oxidation, into acetyl CoA molecules, which enter cell metabolism at the TCA Cycle (Krebs' cycle).



b. **i.** Compare beta-oxidation of free fatty acids with glycolysis.

_____

_____

_____

ii. One of the molecules produced within the inner mitochondrial membrane is NADH.

How does this molecule aid in the production of ATP within the mitochondria?

_____

_____

_____

1 + 2 = 3 marks

Thyroid hormones promote lipolysis. Receptors are found on the membranes of cells in adipose tissue (adipocytes) that stimulate the activation of lipase as well as increasing the expression of receptors on the adipocytes.

c. Explain what 'expression of receptors on the adipocytes' means.

_____

_____

2 marks

Ninety-percent of dietary fat comes in the form of triglycerides. A diet medication called Orlistat works as a reversible inhibitor of pancreatic lipase. It binds to the lipase enzyme, occupying the same site which triglycerides normally would. This inactivates the lipase enzyme for a significant amount of time, allowing 30% of the fat which was taken in from the diet to pass through the intestine without being absorbed.

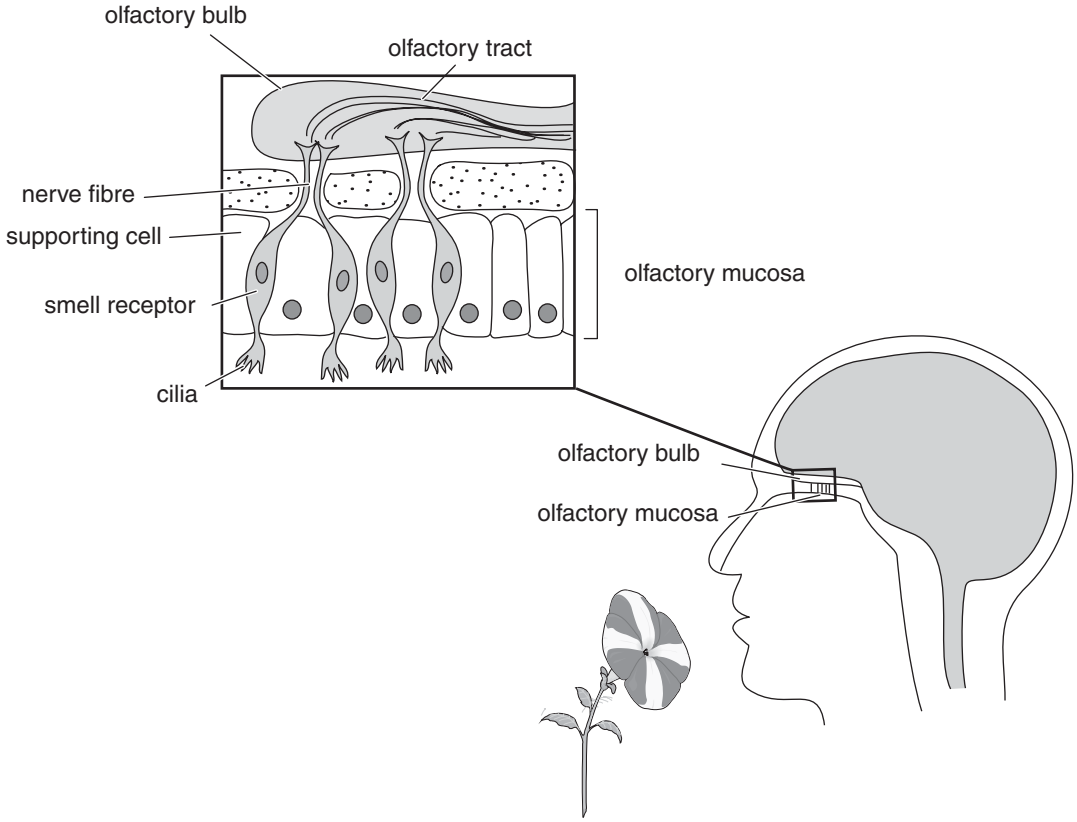
d. Draw a labelled diagram (or series of diagrams) that illustrates the action of Orlistat.

2 marks

Total 8 marks

Question 4

The diagram below is of the smell receptors in the nose.



The sense of smell provides mammals with sensual pleasure, warns them against hazardous substances, and allows them to identify foods, predators, and mates.

a. **i.** Name the general type of nerve that connects the olfactory receptors to the brain.

_____

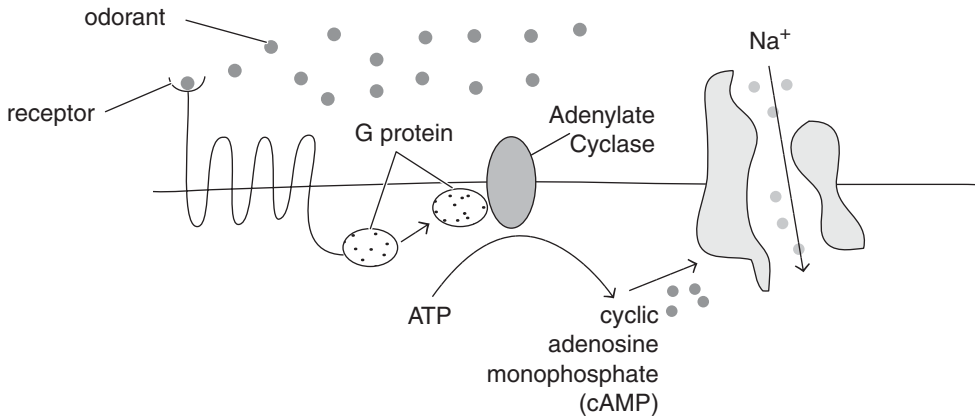
ii. Do you agree with the statement that 'an odour could be a pheromone'? Explain.

_____

_____

1 + 1 = 2 marks

For a certain odour to be detected, a chemical present in the air (odorant) binds to receptors on the surface of the olfactory neuron. This leads to depolarisation of the neuron as illustrated in the diagram below.



b. **i.** Use evidence from the diagram to explain what 'depolarisation of the neuron' means.

_____

_____

_____

ii. What evidence from the diagram shows that this is a signal transduction pathway?

_____

_____

_____

2 + 2 = 4 marks

Humans are able to identify thousands of different odours. Remarkably, only slight changes in the odorant's structure lead people to perceive a different scent. The scientific community was undecided about whether we possess a 'few receptors' that can detect a multitude of odorants or, alternatively, a 'large number of receptors' that respond to only one or a few odorants.

c. State two pieces of scientific evidence that would need to be gathered to support the 'few receptors' hypothesis.

_____

_____

_____

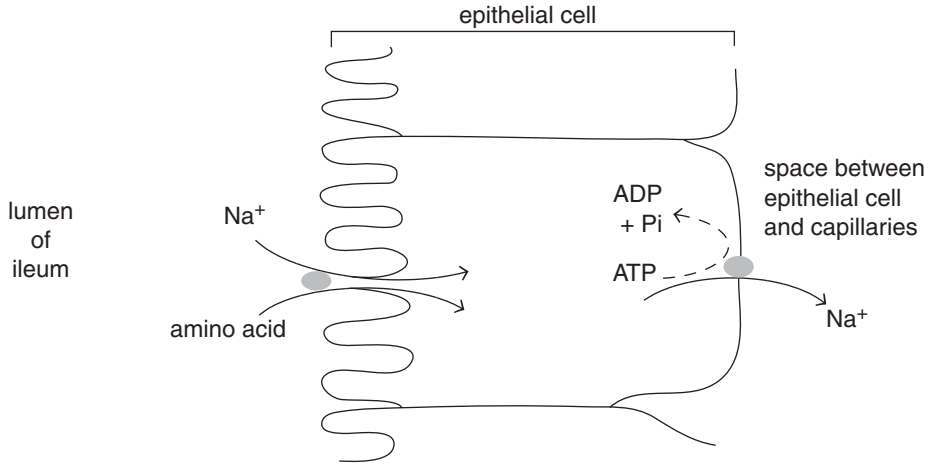
2 marks

Total 8 marks

Question 5

In the small intestine (ileum), proteins are digested into amino acids, which are absorbed and used in the synthesis of human proteins.

The diagram shows how amino acids are absorbed from the lumen (space inside the ileum).



a. **i.** Name the process that enables amino acids to enter the epithelial cell.

_____

ii. Why is active transport of sodium ions out of the epithelial cell important for the continued absorption of amino acids from the ileum?

_____

_____

_____

1 + 1 = 2 marks

Cholera is a water-borne disease, which is caused by a bacterium. The bacterium produces a toxin which acts on the epithelial cells of the small intestine. The cholera toxin affects the movement of ions through the intestinal wall. It causes the loss of chloride ions from the blood into the lumen of the small intestine. This prevents the movement of sodium ions from the lumen of the small intestine into the blood. The resulting high concentration of ions causes diarrhoea.

b. **i.** The cholera toxin only affects the epithelial cells of the small intestine. Suggest why.

_____

_____

ii. Explain why the high concentration of ions in the lumen of the small intestine of a person with cholera causes diarrhoea.

_____

_____

1 + 1 = 2 marks

Vaccination can produce immunity to cholera. A new vaccine appears to provide better immunity and has fewer side effects than previously available vaccines. This vaccine is taken orally. For long-term immunity, a booster dose is required after two years.

c. **i.** The new vaccine for cholera is taken orally but some vaccines are not taken orally. Explain why some vaccines are not taken orally.

_____

_____

_____

_____

_____

ii. Explain why a booster dose of vaccine is required to provide long-term immunity.

_____

_____

_____

_____

2 + 1 = 3 marks
Total 7 marks

Question 6

The ***minimum inhibitory concentration*** (MIC) is the lowest concentration of a substance that prevents the growth of a microorganism.

a. When antibiotics are prescribed for treating patients, why are the recommended doses higher than those necessary to produce the MIC in the blood?

_____

_____

_____

_____

1 mark

Scientists tested a new group of drugs for their effectiveness against four species of bacteria. The scientists used MICs to compare the effectiveness of four drugs. The results are shown in the table below.

	Minimum inhibitory concentration/μg cm^{-3}			
Drug	*Escherichia coli*	*Staphylococcus aureus*	*Enterococcus faecalis*	*Pseudomonas aeruginosa*
P	0.39	0.049	0.049	3.13
Q	1.54	0.049	0.195	3.13
R	0.39	0.049	0.195	1.56
S	1.56	0.098	0.390	12.50

b. **i.** Which of the four drugs is most effective against *Enterococcus faecalis*?

_____

ii. Which of the four drugs is least effective against all the species of bacteria used?

_____

1 + 1 = 2 marks

A person is infected with S*taphylococcus aureus* bacteria. Some of these bacteria are resistant to the antibiotic, methicillin. A doctor gives the person a course of methicillin.

c. What would happen to the proportion of *Staphylococcus aureus* bacteria that are resistant to methicillin? Explain your answer.

_____

_____

_____

_____

_____

2 marks

The number of patients infected with methicillin-resistant *Staphylococcus aureus* (MRSA) has increased in some hospitals. Scientists have suggested ways to reduce the transmission of MRSA in hospitals.

d. Suggest two ways to reduce the transmission of MRSA in hospitals.

_____

_____

_____

_____

2 marks

Total 7 marks

Question 7

Photosynthesis is an essential process in the nutrition of green plants.

a. Write a balanced equation to describe the overall process of photosynthesis by plants.

2 marks

A particular fungus causes a disease in plants. After infecting a plant, the spores of this fungus germinate to form a mycelium, which is a mass of thread-like hyphae. These hyphae penetrate the plant's cells to use the products of photosynthesis as food.

b. Suggest and explain one way in which a plant can

i. resist infection by fungal spores.

_____

_____

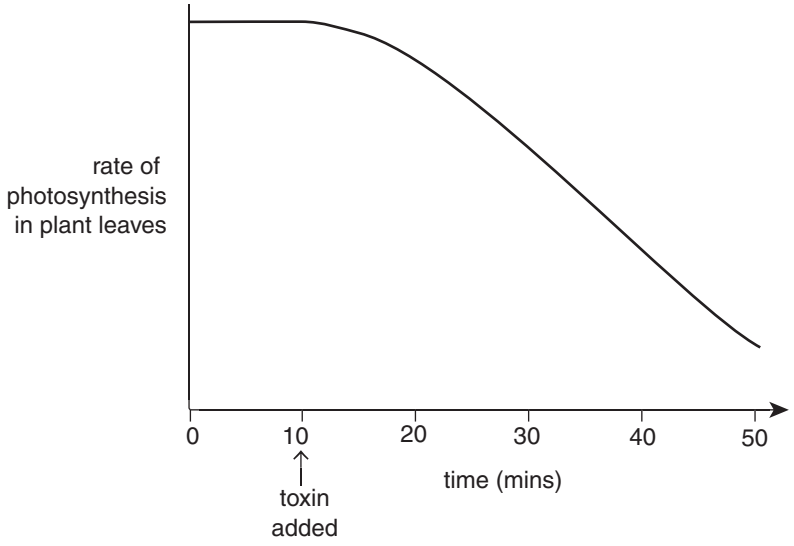
ii. respond to prevent the spread of the mycelium throughout the plant.

_____

_____

1 + 1 = 2 marks

The fungus produces a toxin that rapidly causes stomata in the leaves of plants to close. Scientists measured the rate of photosynthesis in plant leaves, before and after the addition of a dose of the fungal toxin. The graph below shows the results.



c. Describe and explain the results shown in the graph.

_____

_____

_____

_____

_____

2 marks

d. An anti-fungal spray can be used to reduce the effect of the fungus. A gardener wanted to know the minimum dose of spray that would be effective for killing the fungus in infected plants.

Outline the design of an experiment, and the expected results, that would provide a scientific answer for the gardener.

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3 marks
Total 9 marks

END OF QUESTION AND ANSWER BOOKLET