

Student name

# BIOLOGY

## Unit 3

### Trial Examination

#### QUESTION AND ANSWER BOOK

Total writing time: 1 hour 30 minutes

#### Structure of book

Section	Number of questions	Number of marks
A	25	25
B	5	50
	<b>Total</b>	<b>75</b>

- 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 book of 19 pages with a detachable answer sheet for multiple-choice questions inside the front cover.

#### Instructions

- Detach the answer sheet for multiple-choice questions during reading time.
- Write your **name** in the space provided above on this page and 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 book.

*STAV Publishing*  
2006

**BIOLOGY**  
**Unit 3 Trial Examination**  
**MULTIPLE CHOICE ANSWER SHEET**

<b>STUDENT NAME:</b>	
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<b>INSTRUCTIONS:</b>	<b>USE PENCIL ONLY</b>
<ul style="list-style-type: none"><li>• Write your name in the space provided above.</li><li>• Use a <b>PENCIL</b> for <b>ALL</b> entries.</li><li>• If you make a mistake, <b>ERASE</b> it – <b>DO NOT</b> cross it out.</li><li>• Marks will <b>NOT</b> be deducted for incorrect answers.</li><li>• <b>NO MARK</b> will be given if more than <b>ONE</b> answer is completed for any question.</li><li>• Mark your answer by placing a <b>CROSS</b> through the letter of your choice.</li></ul>	

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D
7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	A	B	C	D
11.	A	B	C	D
12.	A	B	C	D
13.	A	B	C	D

14.	A	B	C	D
15.	A	B	C	D
16.	A	B	C	D
17.	A	B	C	D
18.	A	B	C	D
19.	A	B	C	D
20.	A	B	C	D
21.	A	B	C	D
22.	A	B	C	D
23.	A	B	C	D
24.	A	B	C	D
25.	A	B	C	D

**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 crossing the letter that corresponds with your choice of the correct answer.

If you wish to change an answer, erase it and cross 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**

Polypeptides are formed by bonding together molecules called:

- A. amino acids.
- B. monosaccharides.
- C. fatty acids.
- D. proteins.

**Question 2**

The cell organelle involved in the bonding of these units is:

- A. cell membrane.
- B. endoplasmic reticulum.
- C. ribosome.
- D. golgi body.

**Question 3**

DNA and RNA are similar macromolecules in that:

- A. they both contain ribose sugar.
- B. they are both double helices.
- C. they both contain the nitrogen base adenine.
- D. they are both found in the cytosol of the cell.

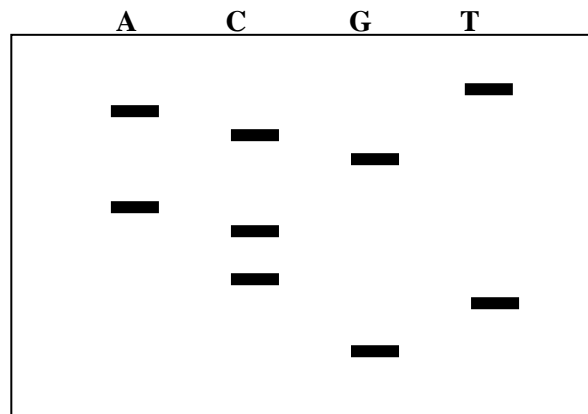
**Question 4**

A lipid consisting of three fatty acids bonded to a glycerol molecule is:

- A. a triglyceride.
- B. a polypeptide.
- C. a polysaccharide.
- D. cholesterol.

**Question 5**

A scientist ran a gel electrophoresis in order to sequence a fragment of DNA. The following gel was obtained.



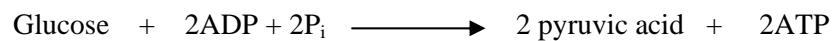
The base sequence of this strand of DNA is GTCCAGCAT

The complementary strand of DNA would be:

- A. GTCCAGCAT
- B. TACGACCTG
- C. CAGGTCGTA
- D. CAGGUCGAU

**Question 6**

The overall biochemical equation below represents a reaction that takes place in a living cell.



This reaction takes place in:

- A. the mitochondria.
- B. the cytosol.
- C. chloroplasts.
- D. ribosomes.

**Question 7**

A student carried out an experiment in which she filled four test tubes with fresh apple juice (a source of glucose) and treated them according to the table below.

Test tube 1	Heated to 85°C	Yeast added after heat treatment
Test tube 2	No heat treatment	Yeast added
Test tube 3	Heated to 85°C	No yeast added
Test tube 4	No heat treatment	No yeast added

All tubes were incubated at 25°C for 24 hours and then tested for the presence of ethanol and acetic acid and their temperatures were taken. The table below shows the results.

Test tube no.	Ethanol	Acetic acid	Final temperature
Test tube 1	present	none	27.0°C
Test tube 2	present	present	28.5°C
Test tube 3	none	none	25.0°C
Test tube 4	none	present	27.5°C

The process of anaerobic respiration took place in:

- A. test tubes 1 and 2
- B. test tubes 1 and 3
- C. test tubes 2 and 3
- D. test tubes 1, 2 and 3

### Question 8

Biological catalysts called enzymes:

- A. are broken down by the cell after each reaction.
- B. are available to be used again after each reaction.
- C. are able to catalyse many different reactions.
- D. raise the activation energy of a chemical reaction by speeding it up.

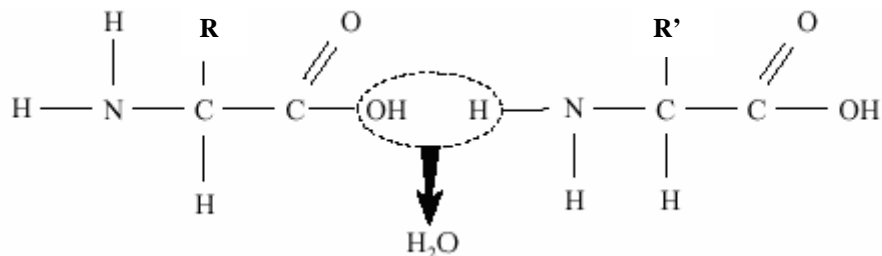
### Question 9

Facilitated diffusion involves movement of a substance across a cell membrane:

- A. from areas of high concentration to areas of low concentration through protein channels or carrier proteins.
- B. from areas of high concentration to areas of low concentration through the lipid bilayer.
- C. from areas of low concentration to areas of high concentration through the lipid bilayer.
- D. from areas of low concentration to areas of high concentration through protein channels or carrier proteins.

**Question 10**

The diagram below shows:



- A. the synthesis of a peptide.
- B. the hydrolysis of a peptide.
- C. the synthesis of a starch molecule from glucose units.
- D. the synthesis of a fat.

**Question 11**

Testosterone is an example of a steroid hormone. Testosterone affects only certain cells called target cells. This is because:

- A. testosterone can only cross the plasma membrane of target cells.
- B. only target cells have the necessary receptors in the cytosol to which the testosterone can bind.
- C. only target cells have the protein receptors on their membranes to which testosterone can attach.
- D. only target cells possess the genes in their DNA that will respond.

**Question 12**

What would be the expected consequences of changing one amino acid in a particular protein?

- A. The primary structure would be changed but the tertiary structure would be unchanged.
- B. The primary structure would be unchanged and the tertiary structure would be changed.
- C. The primary structure would be changed and the tertiary structure may be changed.
- D. The primary structure would be unchanged and the tertiary structure would be unchanged.

**Question 13**

A student extracted the pigment chlorophyll from a plant and placed it in a beaker in the light. After some time she tested it for the presence of glucose. Her result and explanation are most likely to be:

- A. Glucose was not detected because the thylakoid membrane was not present.
- B. Glucose was not detected because extracted chlorophyll cannot absorb light of the correct wavelength.
- C. Glucose was formed because light, water and chlorophyll were all present.
- D. Glucose was not detected because the chlorophyll was no longer living.

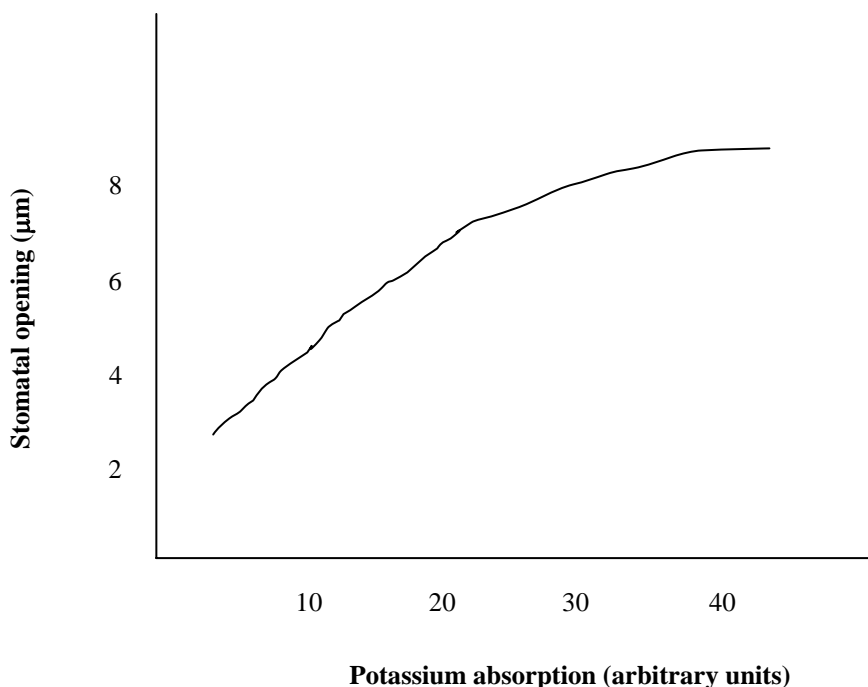
**Question 14**

The Calvin cycle is part of the light independent reaction of photosynthesis. The main function of the Calvin cycle is:

- A. to form ATP.
- B. to split water to form oxygen.
- C. to capture light energy by chlorophyll molecules.
- D. to produce simple sugar molecules from carbon dioxide.

**Question 15 refers to the following information.**

Plants need to control the opening and closing of their stomata in order to minimize their water loss but at the same time allow gaseous exchange for photosynthesis. The relationship between the opening and closing of stomata and the movement of potassium ions into guard cells was investigated as shown in the graph below.

**Question 15**

From the graph it would be reasonable to conclude that:

- A. An increase in the uptake of potassium ions by guard cells is directly proportional to the amount of light falling on the leaf.
- B. An increase in potassium ion uptake by guard cells is accompanied by stomatal opening.
- C. Potassium ions are actively transported into the guard cells during daylight and pass out passively at night.
- D. As the CO<sub>2</sub> concentration increases the stomata begin to close.

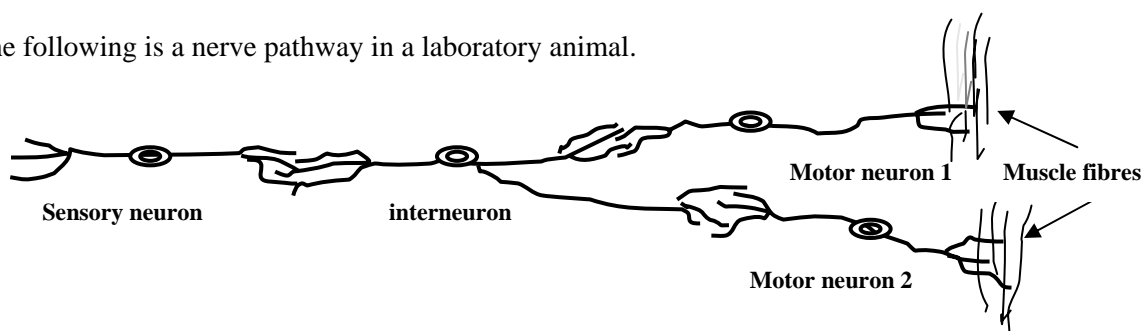
**Question 16**

A virus was grown in the presence of a radioactive isotope of sulfur ( $^{35}\text{S}$ ) so that the viral protein was labeled with the radioactive sulfur. Bacterial cells growing in a medium with non radioactive sulfur were infected with the labeled viruses. The viruses were able to reproduce inside the bacteria. The viruses produced were then isolated and tested. It would be seen that:

- A. these newly formed viruses had  $^{35}\text{S}$  in their DNA.
- B. these newly formed viruses had  $^{35}\text{S}$  in their protein coats.
- C. these newly formed viruses had no  $^{35}\text{S}$  in their protein coats.
- D. the bacterial cells had  $^{35}\text{S}$  incorporated in their DNA.

*Questions 17 and 18 refer to the following information.*

The following is a nerve pathway in a laboratory animal.



Each neuron has a particular threshold level of impulses before it will send an impulse. The following table gives the threshold level that needs to be reached, in impulses per second, by the neurons in this pathway for sending an impulse.

Neuron	Minimum threshold (impulses per second)
Sensory neuron	3
Interneuron	4
Motor neuron 1	6
Motor neuron 2	8

The laboratory animal was subjected to a stimulus, resulting in impulses from the sensory neuron of three impulses per second.

**Question 17**

The impulses from the sensory neuron would:

- A. not be enough to pass to the interneuron.
- B. pass to the interneuron but would not pass to motor neuron 1.
- C. pass to the interneuron and motor neuron 1.
- D. cause contraction of muscle fibres associated with motor neuron 1 but not motor neuron 2.



**Question 18**

A stimulus is applied to the receptor associated with the sensory neuron that is strong enough to bring about contraction of the muscle fibres. A second stimulus is applied that is twice as strong as the first stimulus, it would be reasonable to expect that:

- A. the speed of conduction along the neurons will be twice as fast.
- B. each impulse will be twice as strong.
- C. there will be no response as the nerves are already excited.
- D. the response will be the same.

**Question 19**

The active component of some snake venom is an alpha neurotoxin that binds to receptor sites for acetylcholine. This results in paralysis of muscles. Acetylcholine is:

- A. a neurotransmitter.
- B. a hormone.
- C. an enzyme.
- D. a clotting factor.

**Question 20**

If a person is bitten by a snake it is important that an injection of antivenom be administered as soon as possible. This is an example of:

- A. active immunity.
- B. passive immunity.
- C. non-specific immunity.
- D. an attenuated vaccine.

**Question 21**

Blood fibrinogen is a molecule present in the blood plasma. Blood fibrinogen is converted to fibrin during:

- A. blood clotting.
- B. the immune response.
- C. the formation of complement proteins.
- D. the release of oxygen from red blood cells.

**Question 22**

When a person receives a wound that results in an inflammatory response, which of the following would be expected to occur as part of that response?

- A. Pain would occur as a result of bacteria reproducing in the area.
- B. Complement proteins are produced that attract phagocytes to the area.
- C. Signaling molecules such as histamine travel to the brain to cause fever.
- D. Mast cells release complement protein.

**Question 23**

An infectious self-reproducing agent that consists only of protein is:

- A. a prion.
- B. a proteon.
- C. a proteome.
- D. a peptone.

**Question 24**

The human immune system is able to produce millions of different antibodies. This results from the fact that:

- A. there are millions of antibody genes in B cells.
- B. all antibodies are able to bind by an induced fit to all antigens.
- C. a single antibody gene is responsible for the formation of an antibody that is capable of varying its structure to match any antigen.
- D. antibody genes are assembled from different segments of DNA that are spliced together giving a new antibody gene that is unique.

**Question 25**

The human immune system is made up of different types of cells. One of these cell types, the cytotoxic T cells, are responsible for:

- A. production of antibodies against free pathogens.
- B. destroying soluble products of pathogens.
- C. destroying virus infected and abnormal cells.
- D. engulfing bacteria at the site of the infection.

**END OF SECTION A**

**SECTION B - Short Answer Questions****Specific instructions for Section B**

This section consists of 5 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 biomacromolecules protein, polysaccharides and lipids all contain the elements carbon, hydrogen and oxygen.

- a** What other 2 elements are present in protein that are not present in fats and polysaccharides?

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(2 marks)

Both lipids and polysaccharides are important energy storage macromolecules. Plants store their main energy reserves as a polysaccharide.

- b** Name the main storage polysaccharide of plants.

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(1 mark)

- c** Name the subunits that combine to form the polysaccharide named in **b** above.

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(1 mark)

Animals use both polysaccharide and lipids as storage molecules. Lipids give more energy per gram than polysaccharides but polysaccharides are easier to convert to available energy.

- d** Why do animals use both a polysaccharide and lipids as an energy source whereas plants use only polysaccharide?

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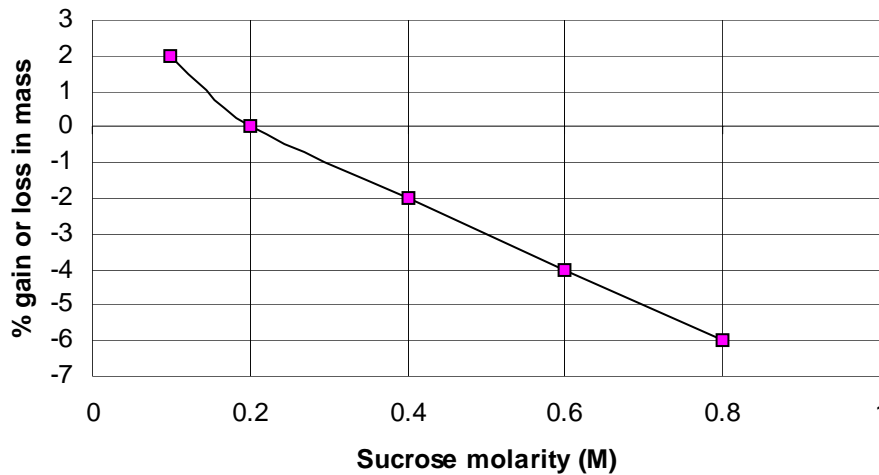
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(2 marks)

**Total 6 marks**

**Question 2**

A student set up an experiment measuring the changes in mass of potato cubes when placed in solutions of sucrose at different concentrations. Five equal-sized cubes were cut from the same potato and their mass recorded. Five test tubes were each filled with sucrose solutions at different concentrations and a potato cube was placed in each. The test tubes were then left for 2 days. The potato cubes were then removed, dried and weighed and the percentage change in weight recorded. The graph below shows the results obtained.



**a** What is a possible hypothesis for this experiment?

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(1 mark)

**b** Name the process that is responsible for the change in mass.

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(1 mark)

**c** What is the independent variable in the experiment?

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(1 mark)

**d** What is the dependent variable in the experiment?

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(1 mark)

**e** Is there a control in this experiment? Explain.

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(2 marks)

**f** From the graph what solute concentration is isotonic to the cells? Give a reason for your answer.

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(2 marks)

**g** The student reasoned that the concentration of sucrose in the potato cells was the same as the value given in **f** above. Is the student correct in this reasoning? Explain your answer.

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(2 marks)

**Total 10 marks**

### Question 3

Thyroxin is a hormone produced by the thyroid gland that increases the metabolic rate of most cells.

**a** What is a hormone?

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(1 mark)

**b** What is one possible way of measuring increase in metabolic rate of cells? Explain your answer.

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(2 marks)

Thyroxin is a small lipid soluble molecule that enters target cells and binds to specific receptors within the nucleus. The Thyroxin-receptor complex affects expression of certain genes within the cell. One such gene is for the substance *fatty acid synthetase*.

**c** What type of chemical substance is *fatty acid synthetase*? Explain your answer.

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(2 marks)

**d** What role would the substance *fatty acid synthetase* have?

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(1 mark)

The production of thyroxin is under homeostatic control as it needs to be secreted at a constant minimum rate as well as have increased production when needed.

**e** Why is it essential that thyroxin is secreted at a constant minimum rate?

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(1 mark)

The production of thyroxin is governed by a negative feedback. The hypothalamus produces the hormone *thyrotrophin releasing hormone* (TRH) as a result of an environmental stimulus such as temperature. The *thyrotrophin releasing hormone* in turn stimulates the anterior lobe of the pituitary gland to secrete *thyroid stimulating hormone* (TSH). It is this hormone (TSH) that influences the synthesis and secretion of thyroxin by binding to a transmembrane receptor on the surface of the thyroid gland. When the concentration of thyroxin rises above the required amount, it inhibits the production of TRH, which influences the production of TSH. High levels of thyroxin also influence the secretion of TSH. The overall outcome is a lowering of the amount of thyroxin.

**f** Draw a flow diagram that depicts the information given above and demonstrates how this is an example of a negative feedback.

(3 marks)

There are many different conditions that affect the thyroid gland. People who have a diet deficient in iodine are unable to manufacture sufficient thyroxin as iodine is needed for thyroxin formation. The lack of iodine may lead to the thyroid gland swelling, forming a goitre.

**g** How would a lack of iodine affect the production of TRH and TSH?

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(2 marks)

Another disease of the Thyroid gland is Graves Disease. The sufferer of this condition produces antibodies that bind to the TSH receptor site mimicking the effect of TSH binding.

**h** What type of disease is Graves Disease? Explain your answer.

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(2 marks)

**i** Would this condition increase or decrease the production of thyroxin? Explain your answer.

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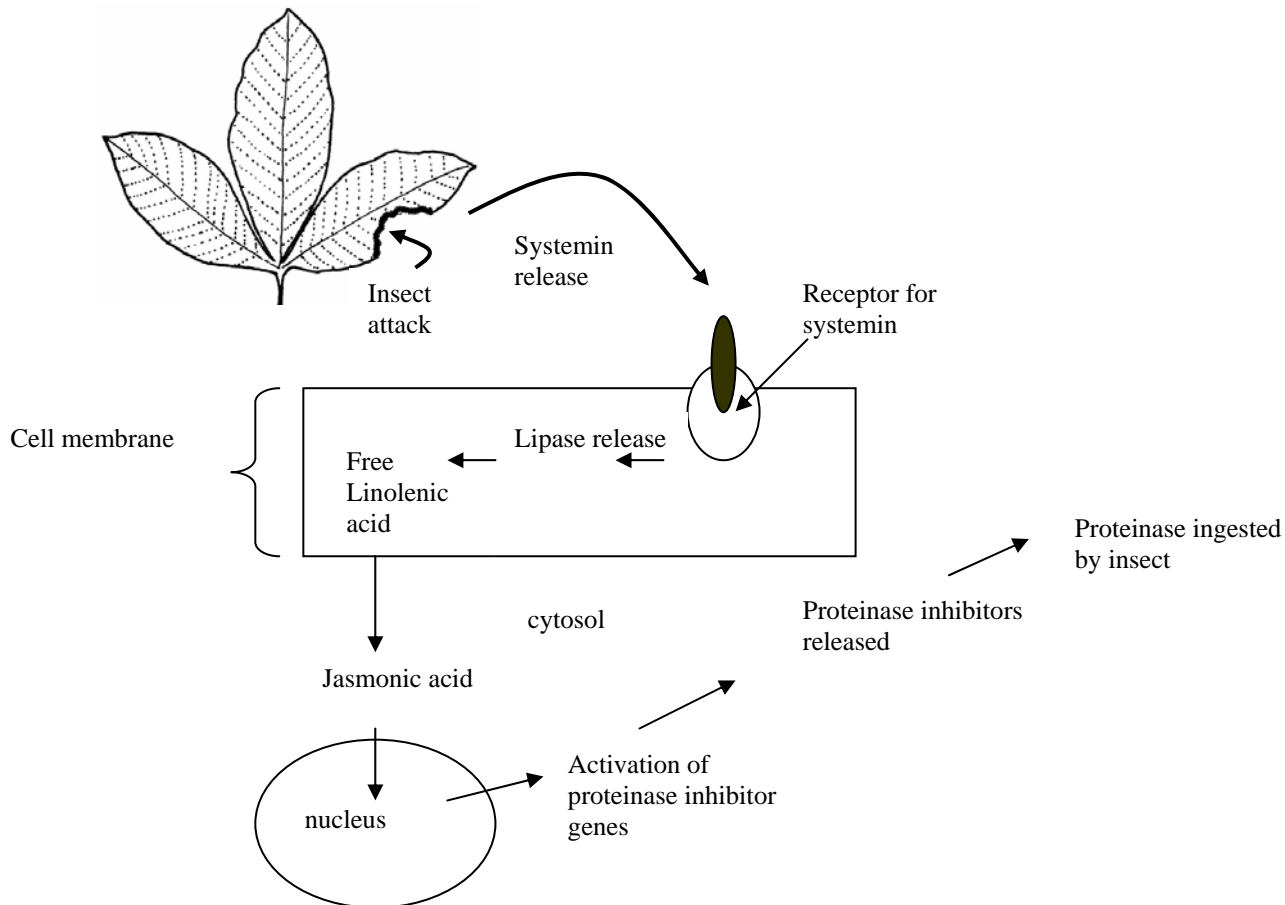
(2 marks)

**Total 16 marks**

**Question 4**

Plants need to protect themselves from infection and attack by other organisms. Some plants produce chemicals to do this. One group of chemicals is the Jasmonates, a group of fatty acid derivatives including jasmonic acid and methyl jasmonate. When plants are attacked by herbivorous insects a small peptide called Systemin is released. This molecule is a signaling molecule that activates a signal transduction pathway that includes the jasmonates. Systemin activates a lipase enzyme in the receptor cell membranes ultimately releasing jasmonates and activating proteinase inhibitor genes. The attacking insect then ingests the proteinase inhibitor.

The diagram below simplifies the series of reactions.



**a** What is a signaling molecule?

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(1 mark)

**b** What is a signal transduction pathway? Give an example from the diagram above.

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(2 marks)



**c** How might the ingestion of the proteinase inhibitor affect the browsing insect?

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(2 marks)

Methyl jasmonate is very volatile and is able to act as an attractant to the predators of the herbivore insect. This acts in a similar way to a pheromone.

**d** How is the action of methyl jasmonate **similar** and **different** from a pheromone?

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(2 marks)

**Total 7 marks**

### Question 5

HIV (Human Immunodeficiency virus) belongs to the group of viruses called retroviruses. These are RNA viruses that are able to copy their RNA into DNA. HIV infects cells of the human immune system resulting in the condition known as AIDs (Acquired Immunodeficiency Syndrome) characterised by the destruction of the immune system. The virus is transmitted by sexual intercourse and contaminated needles.

**a** What is an RNA virus?

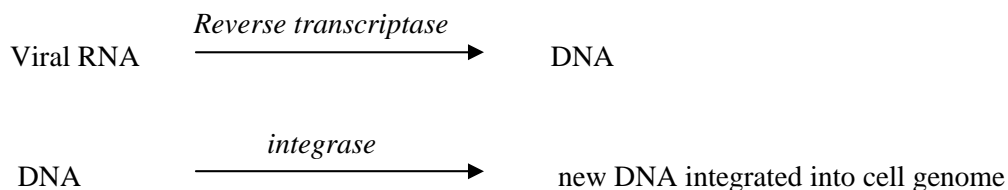
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(1 mark)

This virus has on its surface a protein GP120, that enables it to bind to a receptor site, CD4, on the T helper cell. Once bound to the T cell a viral protein, the HIV RNA and various enzymes are injected into the T cell. The viral RNA is changed to DNA and inserted into the T cell genome according to the equations below.



**b** What type of substances are *reverse transcriptase* and *integrase*?

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(1 mark)

**c** Explain how the viral genetic material can be used to form viral particles.

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(2 marks)

Viral particles, once formed, remain in the T helper cells until the latter are activated, that is, are fighting infection.

**d** What is the role of T helper cells in the human immune response?

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(2 marks)

Medical research has been investigating how to lower the spread of the HIV infection. Vaccine formation against the virus has proved to be difficult. One area being investigated to stop the spread of infection involves the use of nanotechnology. A protein SPL70137 has been synthesised that can mimic the protein CD4 on the surface of the T helper cell that enables HIV to attach to the T cells. This protein SPL70137 has been attached to special synthetic nanoscale molecules called dendrimers and incorporated into a vaginal cream. Should HIV be present in the vagina and this cream is applied, the protein on the dendrimer will bind to the GP120 protein on the HIV particle.

**e** Explain how the application of this cream preparation could help to lower the incidence of HIV infection?

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(2 marks)

**f** How is this treatment different from a vaccination against HIV?

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(2 marks)

**g** Outline a possible problem with the use of the SPL7013 protein.

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(1 mark)

**Total 11 marks**

**END OF EXAMINATION**

Acknowledgements:

Section B, Question 4: the leaf modified from SciArt The New Millenium CD, Cambridge University Press