STAV Publishing 2007

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
	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 book of 16 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.

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STAV Publishing
2007

BIOLOGY
Unit 3 Trial Examination
MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by placing a **CROSS** through the letter of your choice.

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

Nucleotides are:

A. made up of a sugar and a nitrogen base only.
B. found only in nucleic acids.
C. found in nucleic acid and high energy molecules.
D. made up of a nitrogen base and a phosphate group only.

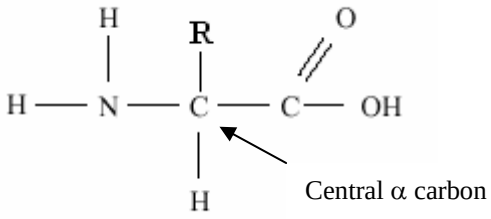
Question 2

The light dependent reaction of photosynthesis:

A. produces oxygen as a product.
B. produces glucose as a product.
C. occurs in the stroma of the chloroplast.
D. involves the reduction of carbon dioxide.

Questions 3, 4 and 5 refer to the following information.

Proteins are biomacromolecules made up of repeating units of amino acids. Proteins have a wide variety of functions. Below is a diagram of an amino acid showing the functional groups attached to a central α carbon atom.



Question 3

The primary structure of a protein:

A. may be an alpha helix.
B. is the sequence of amino acids.
C. is formed by hydrolysis.
D. is the overall 3 dimensional structure.

Question 4

The functional group responsible for the wide variety of functions shown by proteins is:

A. the carboxyl group.
B. the amino group.
C. the α carbon.
D. the **R** group.

Question 5

The cell organelle involved in the bonding of the amino acid units into protein is:

A. the ribosome.
B. the golgi apparatus.
C. the endoplasmic reticulum.
D. the chloroplasts.

Question 6

Small charged ions such as Ca^{2+} and Na^{+} need to pass through the cell membrane. They do this by:

A. dissolving in the lipid bilayer.
B. passing through aqueous pores formed by membrane proteins.
C. passing through spaces between the phospholipid molecules.
D. being engulfed by the cell in a process called endocytosis

Question 7

Mitochondria are important cell organelles as they are involved in:

A. photophosphorylation forming ATP.
B. glycolysis forming ATP.
C. the electron transport chain forming water and 32 ATP.
D. the Krebs cycle forming water and 32 ATP.

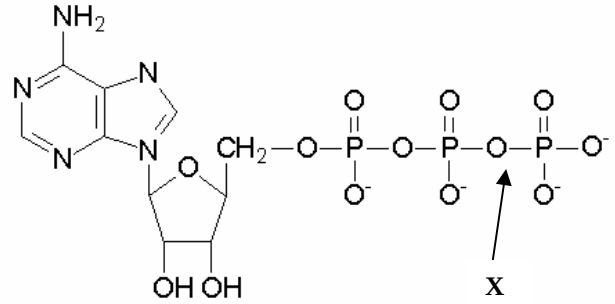
Question 8

The percentage of the base adenine in human DNA is 31.2. This means that:

A. the percentage of cytosine is 18.8
B. the percentage of guanine is 31.2
C. the percentage of thymine is 69.8
D. the percentage of uracil is 31.2

Question 9

The diagram below is an important biological molecule.



When the bond labeled **X** is broken:

A. the molecule is denatured.
B. water is produced.
C. energy is released.
D. the reaction is an endergonic one.

Question 10

Insulin is a peptide hormone produced and released by the Beta cells of the pancreas as a response to high blood glucose levels. Insulin would be transported across the plasma membrane of these Beta cells by:

A. the process of endocytosis.
B. active transport through protein channels.
C. dissolving in the lipid bilayer.
D. the process of exocytosis.

Question 11

Transpeptidase is an enzyme found in some bacteria. Its function is to form petidoglycan, a main component of bacterial cell walls. The antibiotic, penicillin, inhibits transpeptidase by the mechanism of non-competitive irreversible inhibition. Non-competitive irreversible inhibition means that:

A. penicillin binds to the active site of the enzyme transpeptidase, preventing the enzyme from reacting.
B. penicillin binds permanently to the enzyme to a site other than the active site, preventing the enzyme from reacting.
C. penicillin has a similar molecular shape to the true substrate of the enzyme transpeptidase.
D. penicillin denatures the enzyme transpeptidase.

Question 12

A dog being taken for a walk frequently urinates on trees and power poles. The dog is marking out its territory by depositing:

A. a hormone.
B. a nitrogenous waste.
C. a pheromone.
D. a sex attractant.

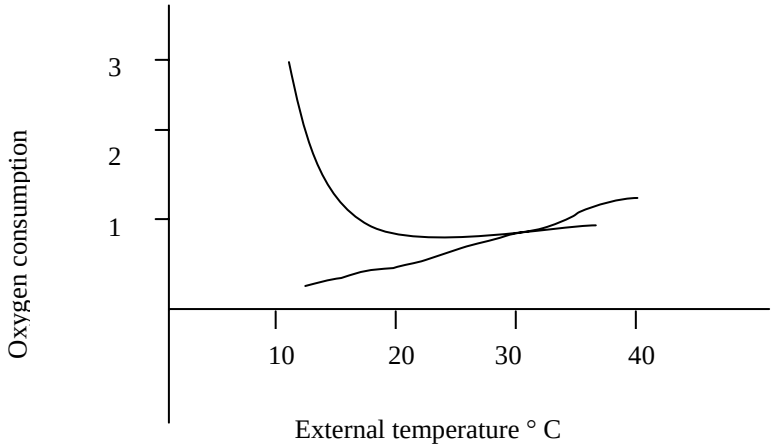
Question 13

The receptors for steroid hormones are to be found:

A. on the plasma membrane of the target cells.
B. in the cytosol of the target cells.
C. within the nucleus of the target cells.
D. as part of G-proteins of the target cells.

Question 14

The following graph shows the change in oxygen consumption of two animals of the same size, one an homoiotherm and the other an ectotherm, as the external temperature changes.



The increase in oxygen consumption in the homoiothermic animal would be due to:

A. increase in external temperature.
B. increased carbon dioxide concentration in the tissues.
C. increased uptake of oxygen by red blood cells.
D. increased cellular respiration.

Question 15

A scientist set up an experiment in which a plant was provided with CO_2 and only water that contained radioactive oxygen, O^{18}. The plant was left in the light to photosynthesize. After some time radioactive O^{18} would be expected to be found in:

A. glucose formed by the plant as a product of photosynthesis.
B. oxygen gas given off by the plant as a product of photosynthesis.
C. water given off by the plant as a product of respiration.
D. carbon dioxide given off by the plant as a product of respiration.

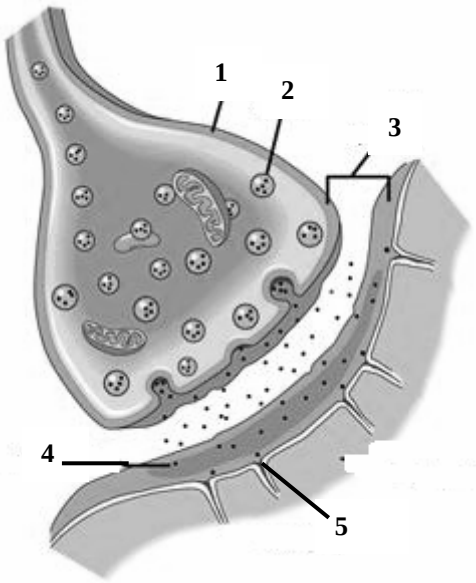
Question 16

A student set up an experiment as shown in the diagram below. A very ripe apple was placed in a sealed plastic bag with 2 unripe bananas. Another plastic bag was set up without the apple.

After a few days the bananas that were in the bag with the apple had ripened but the bananas without the apple had not. The bananas ripened due to:

A. ethylene gas being given off by the ripe apple.
B. methane gas being given off by the ripe apple.
C. the increase in temperature due to the decaying action of the apple.
D. excess carbon dioxide being given off by the ripe apple.

Questions17, 18 and 19 refer to the following diagram



Question 17

In the diagram above what is the function of the structure labelled **2**?

A. It produces ATP in aerobic respiration.
B. It produces hormones needed for target cells.
C. It contains sodium ions for the sodium-potassium pump.
D. It delivers a neurotransmitter to the post synaptic membrane.

Question 18

In the previous diagram the structure labelled **5** is:

A. a sodium-potassium pump.
B. a receptor on a post-synaptic membrane.
C. a synaptic knob.
D. a protein channel on a post-synaptic membrane.

Question 19

The action depicted by substance labelled **4** is an example of:

A. endocrine signalling.
B. paracrine signalling.
C. autocrine signalling.
D. nervous signaling.

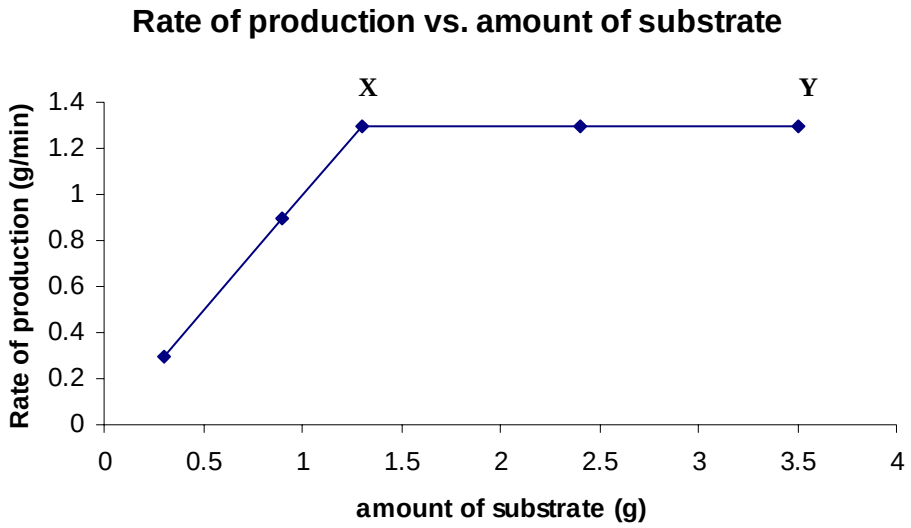
Question 20

The study of the proteome of a cell is important to scientists as it gives information and understanding of:

A. the protein infectious agents and the brain diseases they cause.
B. the primary structure of the particular protein being investigated.
C. the complete array of proteins produced by that cell and their possible interaction.
D. the total genetic information of that cell and the substances that the cell produces.

Question 21

The graph below shows the rate of product production plotted against the amount of substrate for a particular enzyme reaction.



The graph levels off between point X and point Y because:

A. the rate of reaction levels off because all the active sites of the enzyme are temporarily filled.
B. the rate levels off because the enzyme is denatured.
C. the amount of product is constant.
D. the temperature of the reaction has decreased slowing the reaction down to a constant rate.

Question 22

Plants need to protect themselves from pathogenic fungal infections. One way some plants do this is to:

A. produce antibodies that move in the phloem.
B. produce antibodies that move in the xylem.
C. produce wandering phagocytic cells that ingest fungal spores.
D. produce chitinases that break down fungal cell walls.

Question 23

Artificially acquired active immunity occurs as a result of:

A. a vaccination programme with attenuated pathogens.
B. a person being injected with antibodies from another individual.
C. antibodies crossing the placenta during pregnancy.
D. an individual suffering from a disease and recovering.

Question 24

A person who has a wound that becomes infected experiences an inflammatory response. Part of the inflammatory response includes:

A. complement proteins being released that attract phagocytes to the site of infection.
B. histamines being released that cause the brain to produce a fever that helps kill the bacteria.
C. B lymphocytes differentiating into plasma cells to release antibodies.
D. painful swelling at the site of infection due to the reproduction of invading bacteria.

Question 25

Both Cytotoxic T cells and Natural Killer cells attack virus infected cells. These cells are different in that:

A. Cytotoxic T cells are part of the non-specific immune response whereas Natural Killer cells are part of the specific immune response.
B. Cytotoxic T cells are a form of lymphocyte whereas Natural Killer cells are not.
C. Cytotoxic T cells only attack cells displaying specific viral antigens and Class I cell markers whereas Natural Killer cells attack any cell containing any virus.
D. Natural Killer cells only attack cells displaying specific viral antigens and Class I cell markers whereas Cytotoxic T cells attack any cell containing any virus.

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

Lipids are an example of biomolecules important to living organisms.

a What are the main elements that make up all lipids?

_____

(1 mark)

Cell membranes in all organisms are made up of a type of lipid.

b Name the type of lipid that makes up cell membranes.

_____

(1 mark)

The molecules named above show unique solubility properties due to their structure.

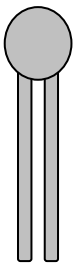
c Describe the structure of these molecules that governs their unique solubility properties.

_____

_____

(2 marks)

These molecules are often represented as shown in the diagram below.



d Draw a diagram, using the model diagram above, that shows the arrangement of these molecules in the cell membrane.

(1 mark)

e Describe why you have drawn the molecules the way you have.

_____

_____

_____

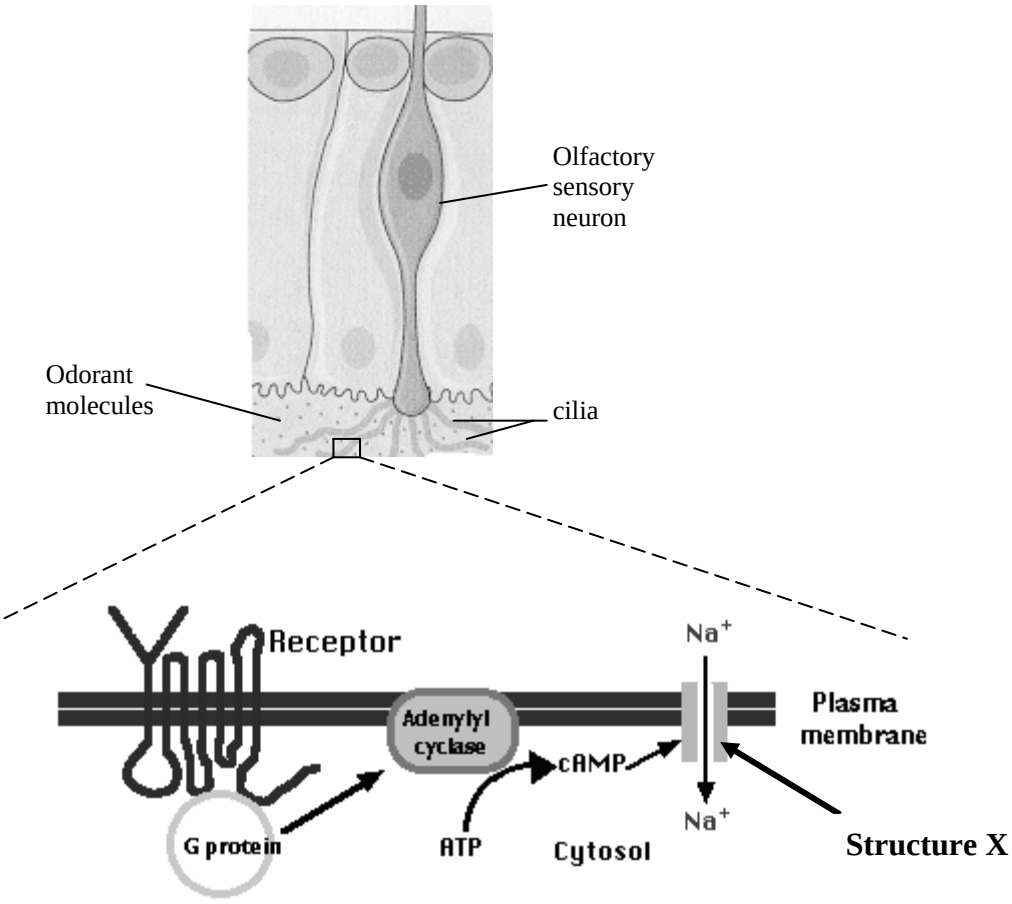
_____

(2 marks)

Total 7 marks

Question 2

The sense of smell depends on sensory receptors that respond to airborne chemicals. In humans these olfactory receptors are located in the olfactory epithelium, situated high in the nasal cavity. These olfactory receptors are sensory neurons with cilia that project into a layer of mucus. Odorant molecules (molecules we can smell) dissolve in the mucus and become bound to receptor molecules on the cilia.



a What feature of the receptor enables an odorant molecule to bind to it?

_____

_____

(1 mark)

b What term is given to the series of reactions triggered by the G protein after the binding of the odorant molecule?

_____

(1 mark)

In the previous diagram the binding of an odorant molecule to the receptor releases a G protein. This activates adenyl cyclase which in turn catalyses the conversion of ATP to cyclic AMP (cAMP). The cAMP causes structure **X** to open. Sodium ions (Na^+) then move into the neuron through structure **X**. With the movement of Na^+ ions into the neuron, an action potential is generated and the message is sent to the brain where the sensation of the particular odour is registered.

c What is structure **X**?

_____

(1 mark)

d By what process do Na^+ ions enter the neuron?

_____

(1 mark)

Humans can discriminate between many different odours.

e Outline how it is possible for a human to do this.

_____

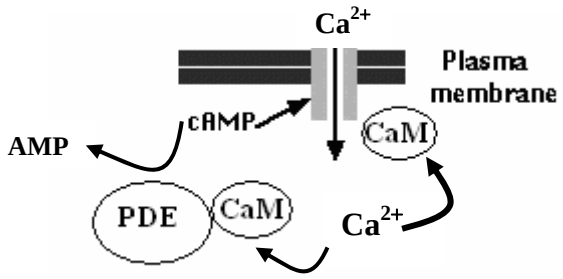
_____

_____

_____

(2 marks)

The olfactory system rapidly adapts to a persistent stimulus. In other words a person gets used to a smell and after a while they do not notice it even though the odour molecules are still there in the same concentration. When the sodium channels open calcium ions also move into the cilia. Ca^{2+} binds to a small calcium binding protein called calmodulin (CaM) forming a Ca^{2+}/CaM complex. The channel has a binding site for Ca^{2+}/CaM complex. The binding of Ca^{2+}/CaM to this binding site reduces the channels sensitivity to cAMP. Also Ca^{2+}/CaM activates an enzyme (PDE) that destroys cAMP. The diagram below outlines the process.



f How does the destruction of cAMP result in a person no longer noticing the smell?

_____

_____

_____

_____

_____

(2 marks)

g Could this feedback mechanism be described as a negative feedback mechanism? Explain your answer.

_____

_____

_____

_____

(2 marks)

Total 10 marks

Question 3

The enzyme β galactosidase is an enzyme found in bacteria that catalyses the following reaction.

$$\text{Lactose} \xrightarrow{\beta\text{ galactosidase}} \text{glucose} + \text{galactose}$$

Lactose is a disaccharide.

a What type of substances are glucose and galactose?

_____

(1 mark)

The chemical ONPG (Ortho-nitrophenyl β D galactopyranoside) which is colourless is also degraded by the enzyme β galactosidase to produce galactose and Ortho-nitrophenyl ONP) which is yellow according to the equation:

$$\underset{\text{colourless}}{\text{ONPG}} \xrightarrow{\beta\text{ galactosidase}} \underset{\text{yellow}}{\text{ONP}} + \text{galactose}$$

This reaction can be used to determine the reactivity of the enzyme β galactosidase. The more intense the yellow colour the more active the enzyme. A student wanted to investigate the effect of an enzyme inhibitor on the activity of β galactosidase at different concentrations of the substrate OPNG. An enzyme inhibitor can be competitive or non-competitive.

b What is:
(i) a competitive inhibitor?

_____

_____

(ii) a non-competitive inhibitor?

_____

_____

_____

(1 + 1 = 2 marks)

The effect of a competitive inhibitor can be reversed by increasing the substrate concentration but the effect of a non-competitive inhibitor cannot.
The student carried out an experiment in order to investigate a particular inhibitor using the enzyme β galactosidase and the substrate ONPG at different concentrations. She obtained the results tabulated below. The greater the absorbance the more active the enzyme is.

ONPG concentration (%)	Absorbance
0. 25	**0. 17**
0. 50	**0. 25**
0.75	**0. 34**
1. 00	**0. 50**

c What variables needed to be kept constant in this experiment?

_____

_____

(2 marks)

d What do the results in this experiment suggest about the method of inhibition shown by this inhibitor? Explain your answer.

_____

_____

_____

(2 marks)

The enzyme activity was measured without the inhibitor at both the beginning and end of the experiment.

e Why would the student measure the activity of the enzyme without the inhibitor?

_____

_____

_____

(1 mark)

The enzyme for this experiment comes in a powder and needs to be made into a standard solution.

f What care is required in handling the enzyme powder when making up the solution?

_____

_____

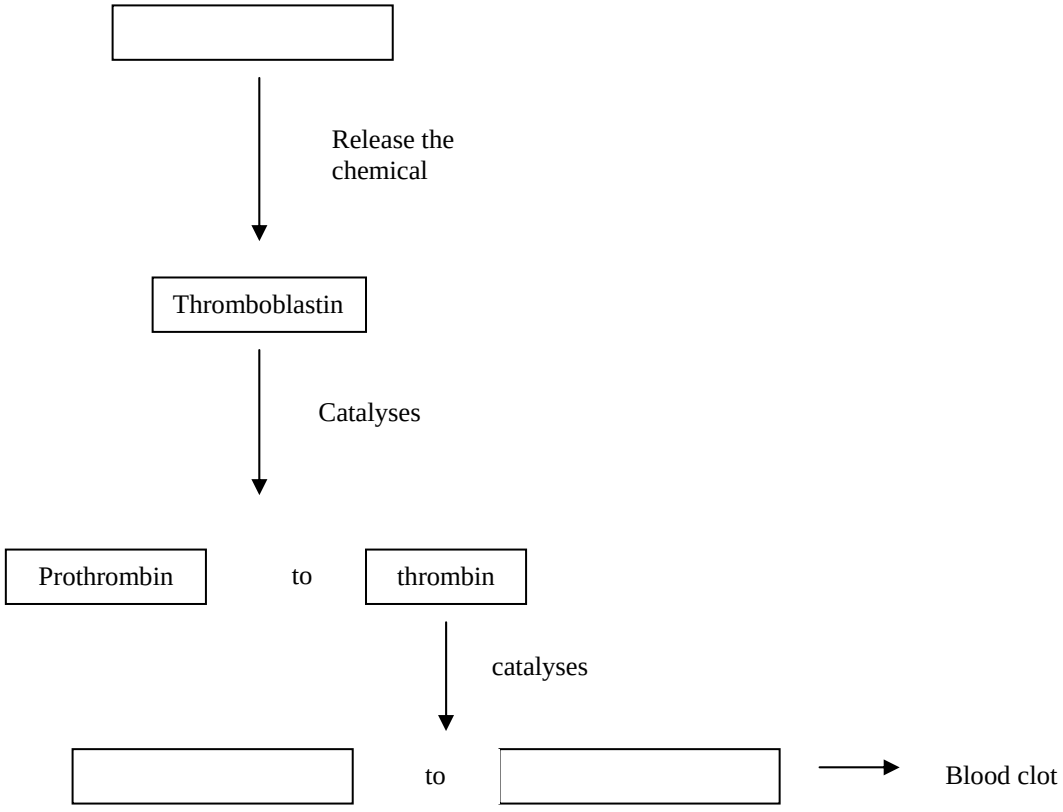
_____

(1 mark)

Total 9 marks

Question 4

Blood clotting is an important mechanism in humans, not only to stem the flow of blood after injury but also to act as part of the body's defence system. The incomplete flow diagram below is a simple version of the blood clotting cascade.



a Complete the diagram by writing in the missing names of the substances and/or components involved in blood clot formation.

(3 marks)

b Explain how the formation of a blood clot can be considered to be part of the body's defence.

_____

_____

_____

(1 mark)

When the injury has healed a protein called plasminogen starts a chain reaction that results in the blood clot dissolving. Plasminogen is present in an inactive form until it is needed, when it is converted into the active form, plasmin that breaks down the clot.
One bacteria, *Group A Streptococcus* that normally causes sore throats, also has the ability to spread rapidly throughout the body with disastrous results. The body responds to the presence of *Group A Streptococcus* by building up blood clots around the infected area. These bacteria, however, produce a substance called streptokinase that has the ability to trigger the body's inactive plasminogen to form active plasmin.

c What effect will the production of streptokinase have on the body?

_____

_____

(1 mark)

d What type of substance would streptokinase be? Explain your answer.

_____

_____

(2 marks)

Laboratory mice, that have the same blood clot dissolving mechanism as humans, are not susceptible to the action of streptokinase produced by these bacteria.

e Explain why laboratory mice are not susceptible to the action of streptokinase.

_____

_____

_____

_____

_____

(2 marks)

Streptokinase has been used as an effective clot dissolving medication to treat people with blocked arteries or blood clots in the lungs. Streptokinase is injected into the bloodstream of the patient as soon as possible after a person has a heart attack in order to break up life threatening blood clots. Streptokinase is a bacterial product so the body will build up immunity to it. It is recommended that a person not be given any more streptokinase four days after the first injection. It is therefore only given for the person's first heart attack.

f What is meant by the statement "the body will build up an immunity to streptokinase"?

_____

_____

_____

_____

_____

(2 marks)

g Why is it not recommended to give streptokinase to the same person should they have a second heart attack sometime later?

_____

_____

_____

_____

(2 marks)

Total 13 marks

Question 5

Allergic reactions to peanuts are one of the leading causes of fatal and near fatal food allergic reactions, especially in children. This type of reaction is referred to as Type 1 hypersensitivity as it happens almost immediately after contact with the peanuts. People have been known to experience anaphylactic shock (a sometimes fatal reaction) with as little as 1mg of peanut substance. The substance(s) in peanuts that bring about this response are called allergens.

a What type of chemical substance would allergens most likely be?

_____

(1 mark)

Part of the allergic response involves the production of IgE or immunoglobulin E

b What is IgE or immunoglobulin E?

_____

(1 mark)

c What cells produce IgE?

_____

(1 mark)

Cells directly involved in the allergic response are mast cells.

d Where are mast cells found?

_____

(1 mark)

e Describe the reaction involving mast cells and IgE that results in the allergic response.

_____

_____

_____

_____

_____

_____

_____

(3 marks)

A method of diagnosis is to perform a radio allegro sorbent test (RAST). This test involves attaching the peanut allergen to paper discs that are then reacted with the patient's serum. This reaction is measured quantitatively.

f Would a more positive result indicate that the patient would have a more severe response to peanuts? Explain your answer.

_____

_____

_____

_____

_____

(1 mark)

Immunotherapy is often used as a treatment for hypersensitivity. This involves injecting the sensitive individual with very small amounts of allergen at first and then gradually building up the injected dose of allergen over a period of many months. This causes the individual to form IgG against the allergen and the person becomes desensitized.

g Outline how this desensitizing procedure lowers the allergic response?

_____

_____

_____

_____

(2 marks)

h Suggest why doctors have been reluctant to use this approach to individuals with peanut allergies.

_____

_____

_____

(1 mark)

Total 11 marks

END OF EXAMINATION

Acknowledgements
Section A Q 16 diagram sourced from: Biology Common Threads Teachers Resource Book Part 2, Australian Academy of Science, page 88
Websites: www.goshen.edu/physics/research/biophysics
http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/O/Olfaction.html