

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	6	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 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

2012

BIOLOGY

Unit 3 Trial Examination

MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	
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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 **SHADING** the letter of your choice.

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

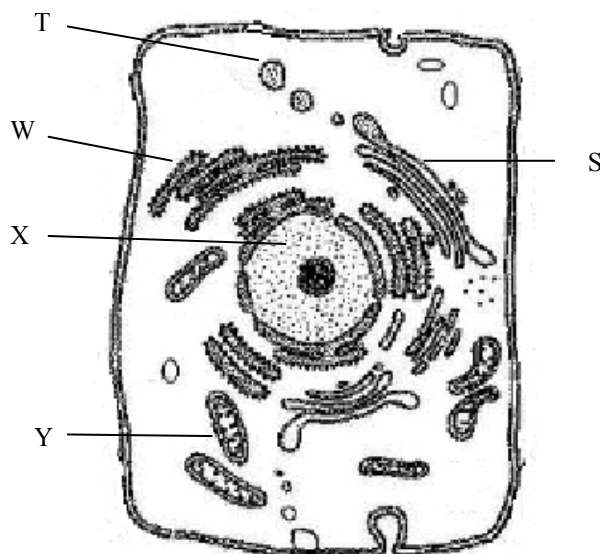
Each question is worth **one** mark. **No** mark will be given if more than one answer is completed for any question. Marks will **not** be deducted for incorrect answers.

Question 1

Three structures that may be found in prokaryotic cells, but not in eukaryotic cells would be:

- A. circular DNA, plasmids, capsid.
- B. ribosomes, circular DNA, cellulose cell-wall.
- C. plasmids, ribosomes, capsule.
- D. circular DNA, non-cellulose cell-wall, plasmids.

The following diagram applies to Question 2 and Question 3.

**Question 2**

The animal cell above secretes a protein into the bloodstream.

The correct order of passage of an amino acid that forms part of the protein would be:

- A. X → W → T
- B. W → S → T
- C. Y → W → T
- D. W → Y → T

Question 3

It is reasonable to state that:

- A. DNA would be found in X only.
- B. RNA would be found in W, X and Y.
- C. RNA would be found in W only.
- D. DNA would be found in X, Y, W and T.

Question 4

Water is a reactant in the process of photosynthesis. One function of water is to:

- A. provide oxygen for the light-independent reaction.
- B. provide high energy electrons for the light-dependent reaction.
- C. react with carbon dioxide in the light-independent reaction.
- D. absorb light in the light-dependent reaction.

Question 5

The exoskeleton of insects is made of the biomolecule chitin. Chitin is a derivative of cellulose. It is reasonable to state that chitin:

- A. is a polysaccharide.
- B. is a protein.
- C. can be broken down by the enzyme cellulase.
- D. cannot be broken down by enzymes.

Question 6

A substance classified as a lipid:

- A. has the molecule held together by peptide linkages.
- B. can be hydrolysed to fatty acids and glycerol.
- C. contains the elements hydrogen and oxygen in a ratio of 2:1.
- D. is a polymer.

Question 7

Which of the following reactions are exergonic?

- A. amino acid A + amino acid B $\longrightarrow$ dipeptide
- B. $\text{ADP} + \text{P}_i \longrightarrow \text{ATP}$
- C. glucose + fructose $\longrightarrow$ sucrose
- D. triglyceride + water $\longrightarrow$ 3 fatty acids + glycerol

Question 8

When cultivating plant tissues in the laboratory, a scientist wishing to encourage cell division, would apply:

- A. ethylene
- B. abscisic acid
- C. cytokinin
- D. gibberellins

Question 9

Mammals have axons that are myelinated whereas invertebrates such as squid do not. The table below compares the average speed of conduction in two animals.

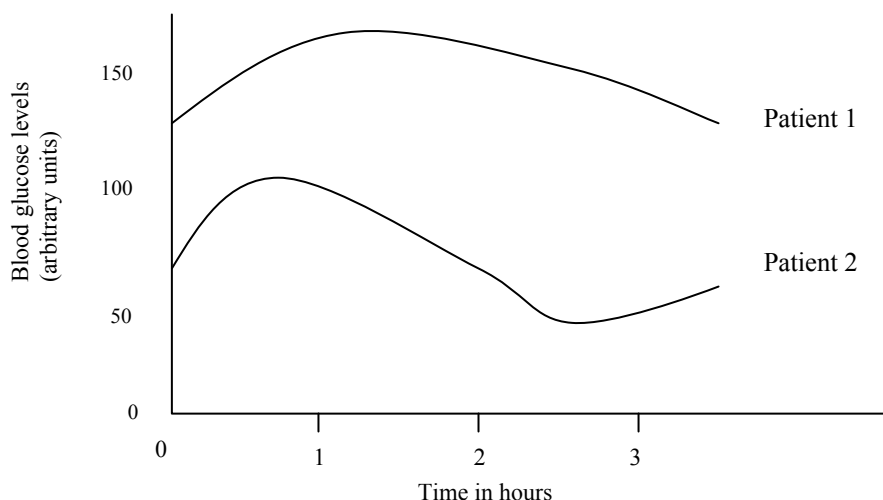
Animal	Diameter of axon μm	Conduction velocity m/sec
squid	650	24
cat	4	26

From this data and your knowledge of biology, it is reasonable to state that:

- A. myelinated nerves are always faster than unmyelinated nerves.
- B. the cat can respond faster than the squid.
- C. myelinated nerves are more efficient in nerve conduction than unmyelinated nerves.
- D. myelin interferes with conduction in myelinated nerves unless the nerves are small in diameter.

Question 10

Blood glucose levels are controlled by homeostasis. Inability to balance blood glucose levels results in the condition diabetes. A test for diabetes is a glucose tolerance test. The person being tested does not eat anything for at least 10 hours. An initial blood sample is taken and the blood sugar is measured and then the person is given a glucose drink containing 75 grams of glucose. The person then has their blood tested again 30 minutes, 1 hour, 2 hours and 3 hours after drinking the high glucose drink. The graph below shows the results of two patients being tested for diabetes.



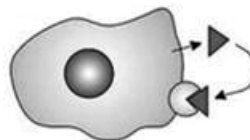
From the graph it would be reasonable to state:

- A. patient 1 has diabetes as the level of blood glucose is higher after fasting and remains high after intake of glucose.
- B. patient 2 has diabetes as glucose levels go up and down.
- C. both patients have diabetes as glucose should be at a constant level in the blood.
- D. neither patient has diabetes as levels of glucose are returning to the normal level for each individual.

Question 11

The diagram on the right shows an example of:

- A. endocrine signalling.
- B. paracrine signalling.
- C. autocrine signalling.
- D. signal transduction.

**Question 12**

Many cells secrete chemical molecules. Of the following, which cell is correctly paired with the molecule it secretes?

Type of cell	Chemical molecule
A. B cell	complement proteins
B. Striated muscle cell	acetylcholine
C. Natural killer cell	interferon
D. Mast cell	histamine

Question 13

Testosterone is a steroid hormone produced by the cells of the testes. The structure within the testes cell that would produce this hormone would be the:

- A. nucleus.
- B. smooth endoplasmic reticulum.
- C. rough endoplasmic reticulum.
- D. golgi body.

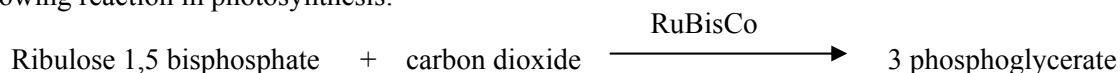
Question 14

There is an average of 600 to 700 lymph nodes in the human body. The function of these lymph nodes is to:

- A. produce lymph.
- B. produce lymphocytes.
- C. produce antibodies.
- D. filter the lymph.

Question 15

The enzyme, ribulose-1,5 biphosphate carboxylase oxygenase called “RuBisCo” is one that catalyses the following reaction in photosynthesis:

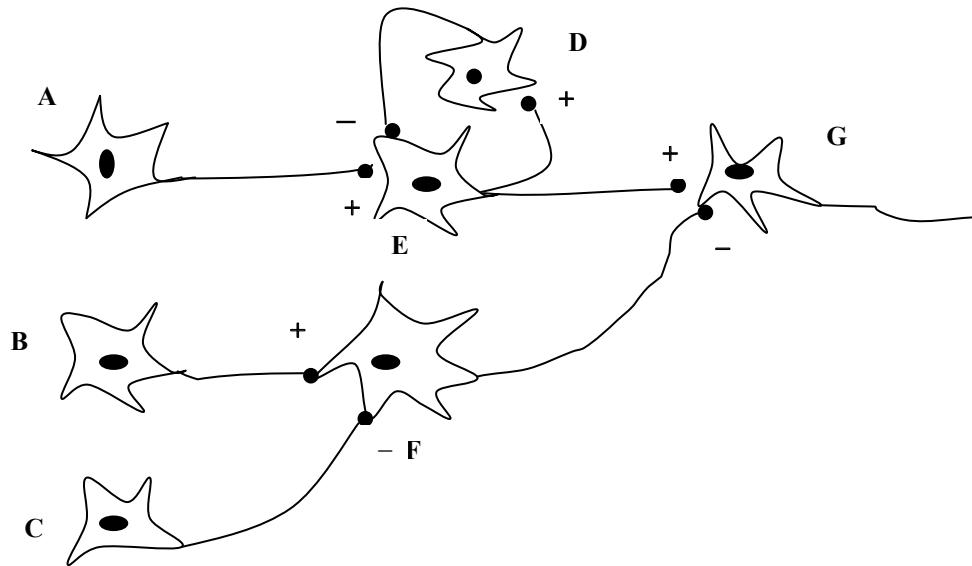


This reaction is part of:

- A. the light-independent stage and would take place in the stroma of the chloroplast.
- B. the light-dependent stage and would take place in the stroma of the chloroplast.
- C. the light-dependent stage and would take place in the grana of the chloroplast.
- D. the light-independent stage and would take place in the grana of the chloroplast.

Question 16

The following neuron circuit diagram shows excitatory synapses and inhibitory synapses.



You would expect:

- A. Neuron **G** would not fire off if **A**, **B** and **C** all fired off simultaneously.
- B. Neuron **G** would fire off if neurons **B** and **C** are fired off simultaneously.
- C. Neuron **G** would not fire off if neurons **A** and **B** are fired off simultaneously.
- D. Neuron **G** would not fire off if neurons **A** and **C** are fired off simultaneously.

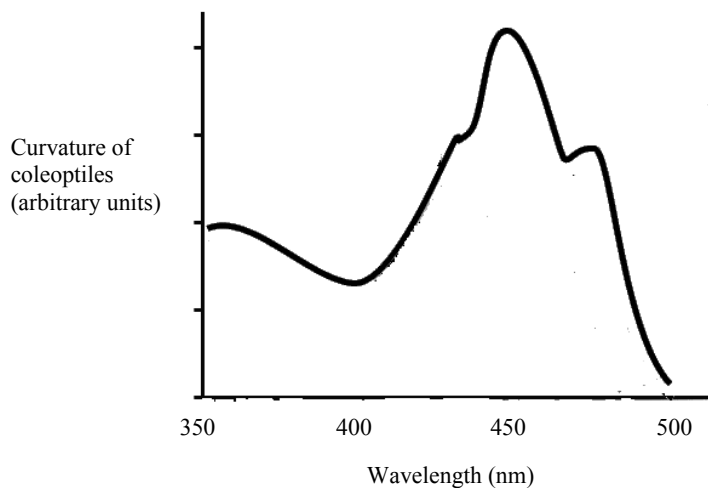
Question 17

Sickle cell anaemia is a genetic disease due to a mutation in the genetic code resulting in a change in the structure of the protein haemoglobin. Haemoglobin consists of 4 polypeptide chains and is responsible for transporting oxygen. In sickle cell anaemia the sixth amino acid in one of the peptide chains is the hydrophobic amino acid valine, which replaces the hydrophilic amino acid glutamine in the normal polypeptide chain. The DNA code for valine is GTG and the DNA code for glutamine is GAG. This difference:

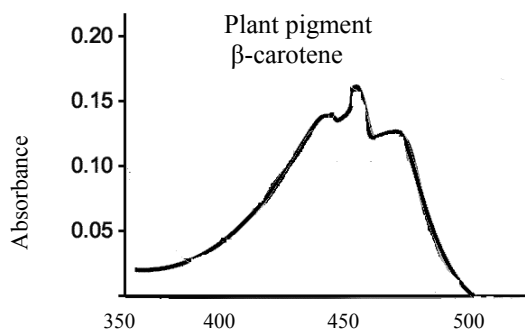
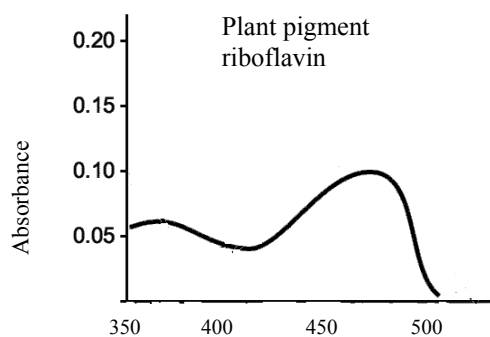
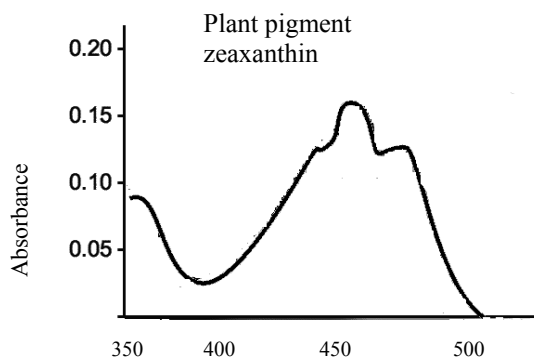
- A. results in the haemoglobin not being able to function as the active site has a different amino acid.
- B. results in a hydrophobic region on the polypeptide chain that will be attracted to the hydrophilic part of another peptide chain, causing a change in shape of the molecule.
- C. results in a hydrophobic region on the polypeptide chain that will be attracted to the hydrophobic part of another peptide chain, causing a change in shape of the molecule.
- D. has resulted because thymine replaced adenine in the DNA and replacement of complementary base pairs always results in hydrophobic amino acids replacing hydrophilic amino acids.

Question 18

The relationship between the curvature of an oat coleoptiles and the wavelength of light to which it is exposed is shown in the following graph. Blue light has a wavelength of 450 - 495 nm.



Scientists examined the absorption spectra of three different plant pigments to decide if any could be the photoreceptor responsible for the curvature of the oat coleoptiles. The following absorption spectra are shown for the three pigments investigated.



From this data it would be reasonable to conclude:

- A. all three plant pigments are the photo receptors for curvature as they all absorb blue light.
- B. plant pigment β -carotene is the photoreceptor for oat coleoptile curvature.
- C. plant pigment zeaxanthin is the photoreceptor for oat coleoptile curvature.
- D. plant pigment riboflavin is the photoreceptor for oat coleoptile curvature.

Question 19

Prions are responsible for neurological diseases in mammals, including humans.
Prions are:

- A. proteins that are present in the cell that have been modified to become infective agents.
- B. proteins formed in the cell after invasion by a virus.
- C. proteins that were once part of the cell membrane and escape when the cell bursts and they invade other cells.
- D. proteins that are formed after mutations in the DNA of the cell.

Question 20

The RNA virus that causes influenza in humans:

- A. replicates in the nucleus of the host cell.
- B. is able to invade all types of human cells.
- C. contains both RNA and DNA in order to make viral particles.
- D. is taken into specific cells by receptor mediated endocytosis.

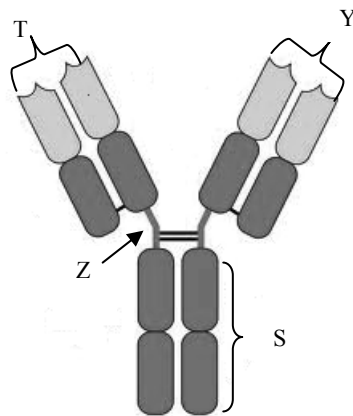
Question 21

Macrophages are one type of cell involved in the immune response. Macrophages:

- A. produce antibodies.
- B. specifically attack virus-infected cells.
- C. present antigens on their surface to T-helper cells.
- D. become memory cells after infection.

Question 22

Below is a diagram of an antibody.

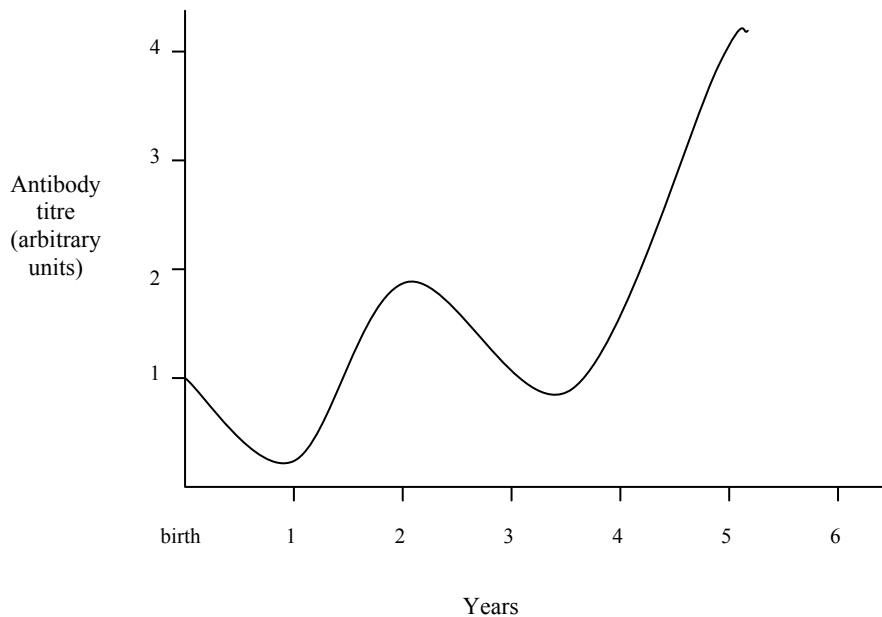


It is reasonable to state that:

- A. T is a binding site for one antigen and Y is a binding site for another antigen.
- B. the area labelled Z enables the antibody to bend to give flexibility in binding to the antigen.
- C. the darker shaded area is the heavy chain.
- D. the area labelled S is the constant region in all antibodies.

The following information applies to Questions 23 and 24.

The graph below shows the levels of antibodies against mumps in the blood of a child from birth to 6 years.



Question 23

From this graph it could be concluded that:

- A. the mother of this child never had the mumps prior to giving birth to this child.
- B. the child caught mumps at 3 years and again at 5 years.
- C. the child was vaccinated against the mumps at 12 months and again at 4 years.
- D. the child will need to be vaccinated every 3 years.

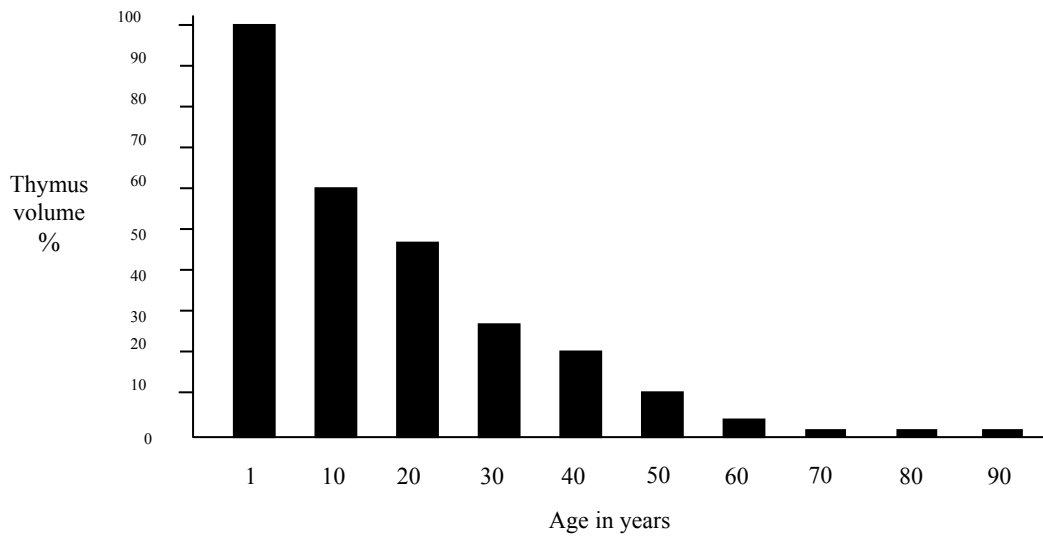
Question 24

The antibody titre reading at birth is an example of:

- A. naturally acquired passive immunity.
- B. naturally acquired active immunity.
- C. artificially acquired passive immunity.
- D. artificially acquired active immunity.

Question 25

The thymus gland reduces in size with age as shown in the graph below.



From this data it would be reasonable to state that:

- A. children in their first 10 years are less subject to infection.
- B. people who are older than 50 years suffer more from viral diseases.
- C. the production of new or naive T cells is affected more in people who are in their 50s, but the production of T memory cells will not be altered.
- D. the production of both naive T cells and T memory cells decreases with age.

END OF SECTION A

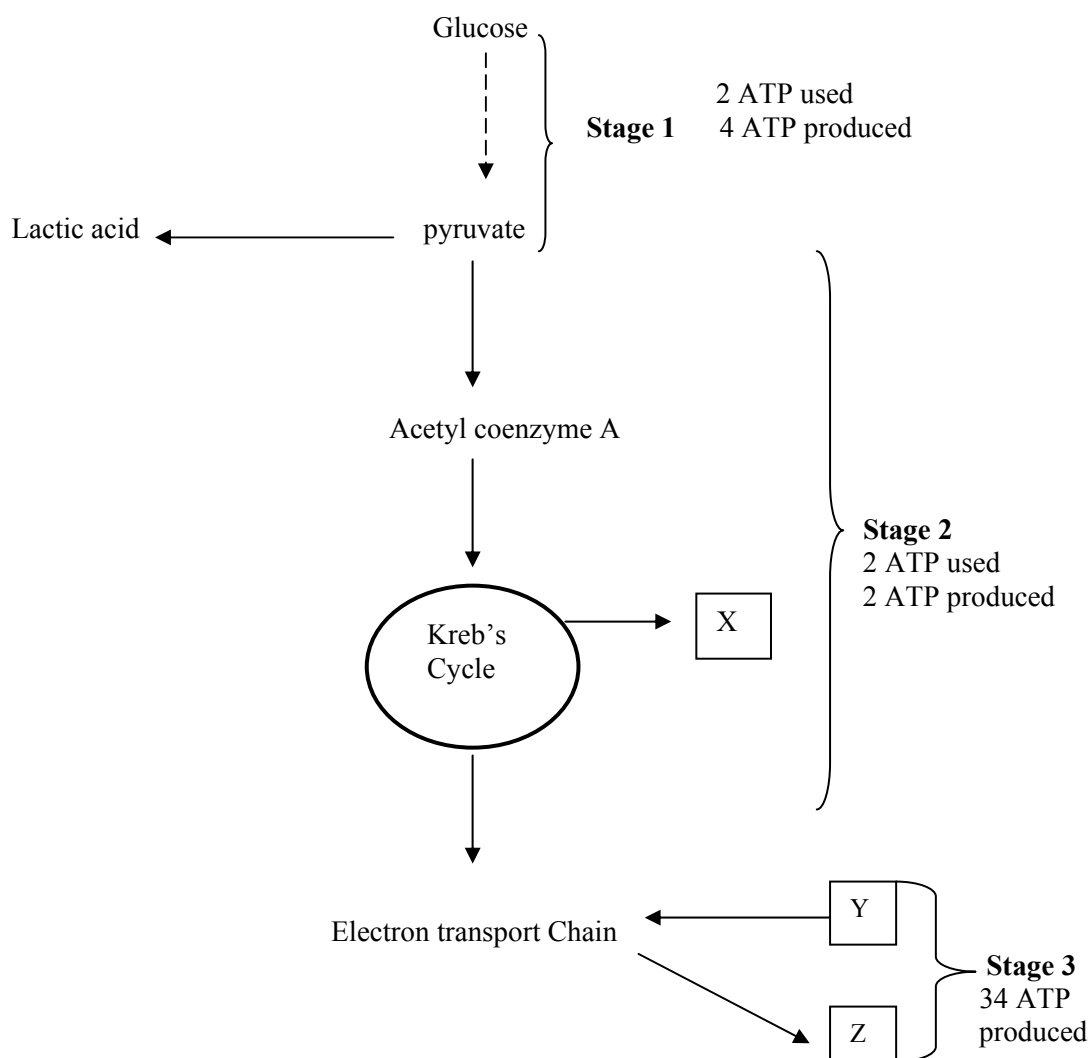
SECTION B - Short Answer Questions**Specific instructions for Section B**

This section consists of 6 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 flow diagram below represents aerobic respiration occurring in a cell.



- a** Write the overall balanced equation for aerobic respiration.

(1 mark)

- b** State exactly where in the cell the stages shown on the diagram take place.

Stage 1 _____

Stage 2 _____

Stage 3 _____

(3 marks)

- c** Identify the structures X, Y and Z shown on the diagram.

In stage 2, X is _____

In stage 3, Y is _____

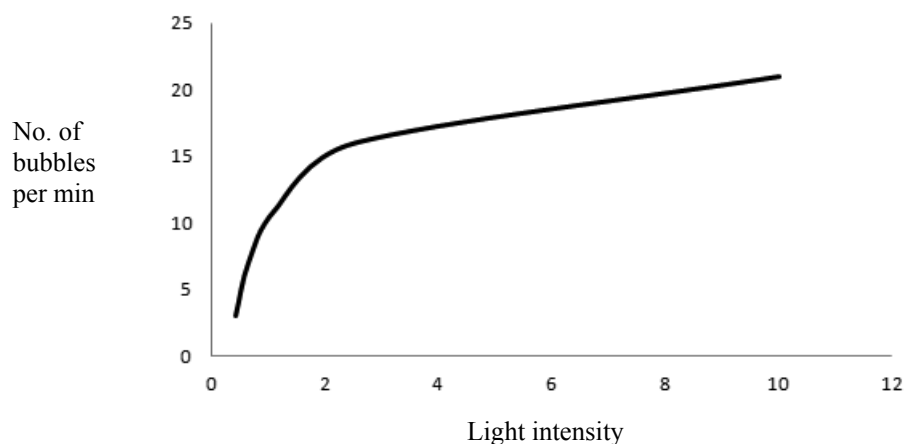
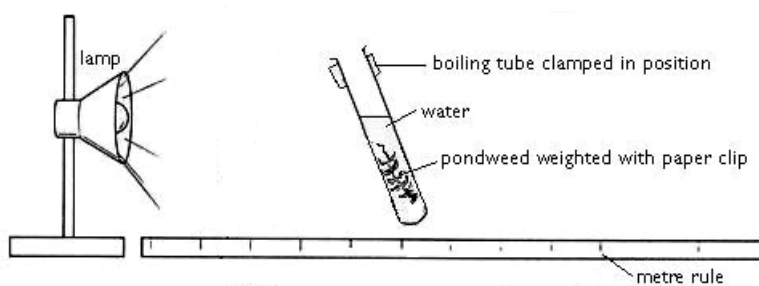
In stage 3, Z is _____

(3 marks)

Total 7 marks

Question 2

Students investigated the effect of light intensity on a photosynthesising water plant. A water plant was placed in a 1% sodium hydrogen carbonate solution. The rate of photosynthesis was determined by counting the bubbles when the light source was placed at various distances from the plant. A graph was drawn of the average number of bubbles per minute against light intensity.



a What is the dependent variable in this experiment?

(1 mark)

b What is the independent variable in this experiment?

(1 mark)

c What do the results show?

(1 mark)

d What are **two** assumptions made in this experiment?

(2 marks)

e Suggest one source of error in the setup of this experiment.

(1 mark)

f How could the source of error you suggested in **e** be minimised? (You could draw on the diagram to demonstrate your point.)

(1 mark)

A student suggested that for this experiment the solution in which the plant is placed should be changed before each reading.

g Do you agree with this idea? Give a reason for your answer.

(2 marks)

h Why does the graph become straight?

(1 mark)

Total 10 marks

Question 3

Amylases are enzymes that break down starch molecules into their subunits. These enzymes are produced commercially from bacteria that live in hot springs as many industrial processes require enzymes to act in reasonably high temperatures. Amylases are used commercially in the food industry.

a What are the subunits that make up starch?

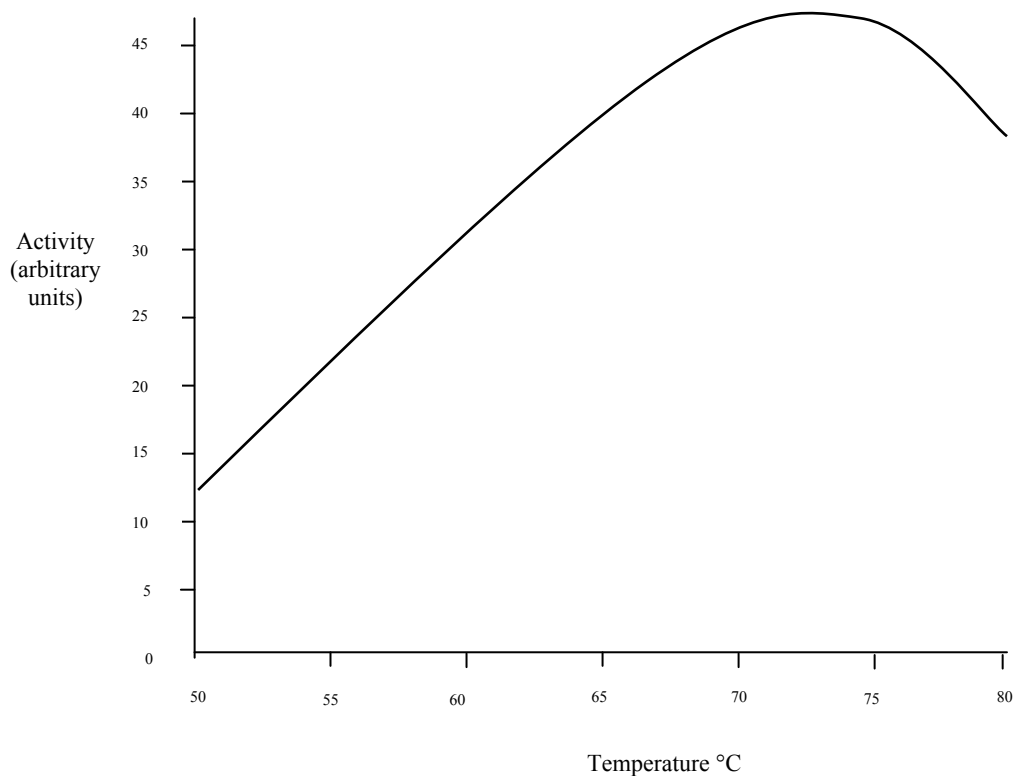
(1 mark)

An enzyme increases the rate of a biochemical reaction.

b How does an enzyme increase the rate of a chemical reaction?

(1 mark)

The graph below shows the effect of temperature on a commercial preparation of amylase.



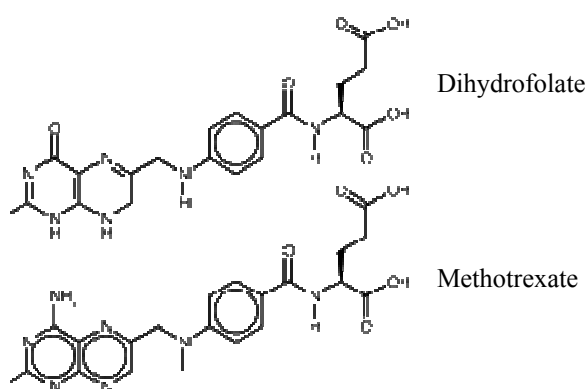
c Explain how temperature affects the enzyme activity between 50°C and 75°C.

(1 mark)

- d** Explain how temperature has affected the enzyme activity between 75°C and 80°C.

(1 mark)

Folic acid or Vitamin B₉ needs to be included in the diet. Dihydrofolate is a substance formed in the liver from folic acid. Dihydrofolate is a substrate for the enzyme *dihydrofolate reductase* in the pathway that leads to the formation of nucleotides. The drug, *Methotrexate*, blocks the action of *dihydrofolate reductase*, and thereby blocks the production of nucleotides. Below is a diagram of dihydrofolic acid and *Methotrexate*.



- e** From the diagram, suggest how *Methotrexate* may act to inhibit the action of the enzyme *dihydrofolate reductase*.

(2 marks)

Methotrexate acts during the 'S' phase of the cell cycle.

- f** What is the 'S' phase of the cell cycle?

(1 mark)

Methotrexate is often used in cancer therapy.

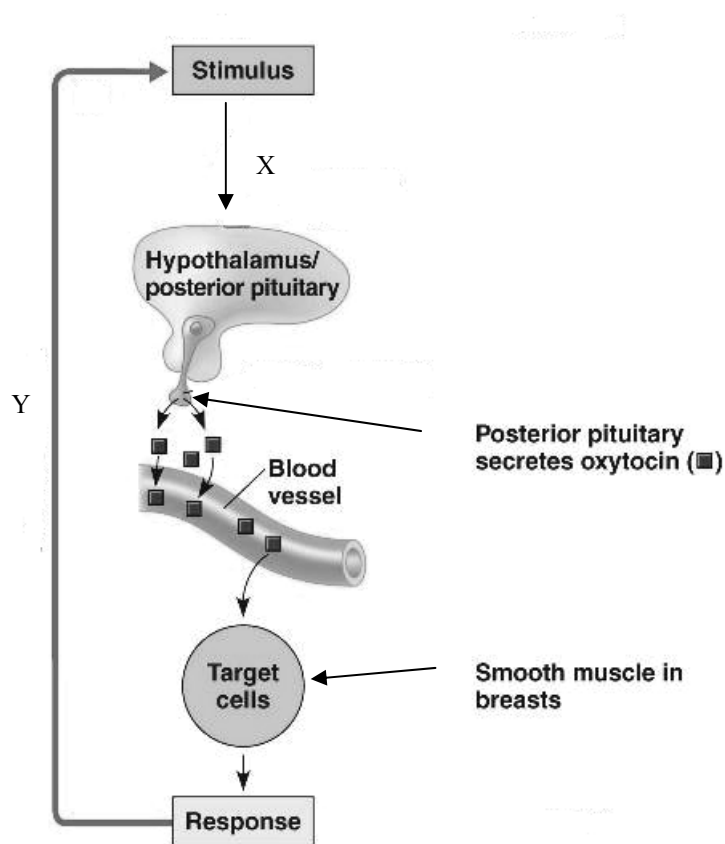
- g** Using this information, suggest why *Methotrexate* is used in the treatment of cancer.

(2 marks)

Total 9 marks

Question 4

When a baby suckles at the nipple, a pathway is set up that results in smooth muscle in the breast contracting and milk being released from the nipple. The pathway is shown below.



- a** What is the stimulus in this pathway?

(1 mark)

- b** What type of substance is oxytocin? Give a reason for your answer.

(2 marks)

The pathway from the stimulus to the hypothalamus is represented by X on the diagram.

- c** What is the name of pathway X?

(1 mark)

Y represents a feedback in this pathway as shown on the diagram.

d Is this pathway a negative or a positive feedback? Explain your answer.

(2 marks)

e Outline the steps represented by this pathway.

(2 marks)

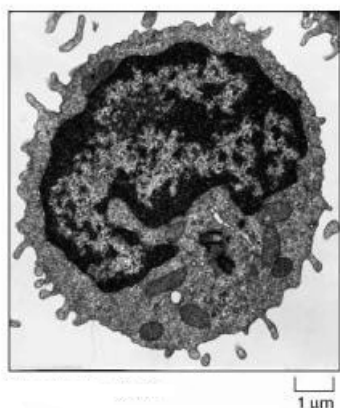
f Is this an example of homeostasis? Explain your answer.

(1 mark)

Total 9 marks

Question 5

The electron micrographs below are of a plasma cell and the B lymphocyte from which it was formed.



B lymphocyte



Plasma cell

a What is the function of the plasma cell?

(1 mark)

b Use the diagrams to comment on the relative sizes of these two cells.

(1 mark)

c Suggest **two** reasons for the difference in the organelles present in these two cells.

(2 marks)

A lung transplant is an option for patients suffering from the condition cystic fibrosis. However there is a risk of rejection of the transplanted organ and immunosuppressant drugs are given to reduce this risk.

d Why does tissue rejection occur?

(1 mark)

e Name the cells of the immune system responsible for the rejection of transplanted organs.

(1 mark)

f Outline the process of tissue rejection that could occur in such a patient after a lung transplant.

(2 marks)

Total 8 marks

Question 6

Chilli peppers, plants belonging to the Genus *Capsicum*, contain the hydrophobic chemical capsaicin which is found in the membrane tissue of the plant that holds the seeds. When chillies are eaten, capsaicin produces a painfully hot sensation.

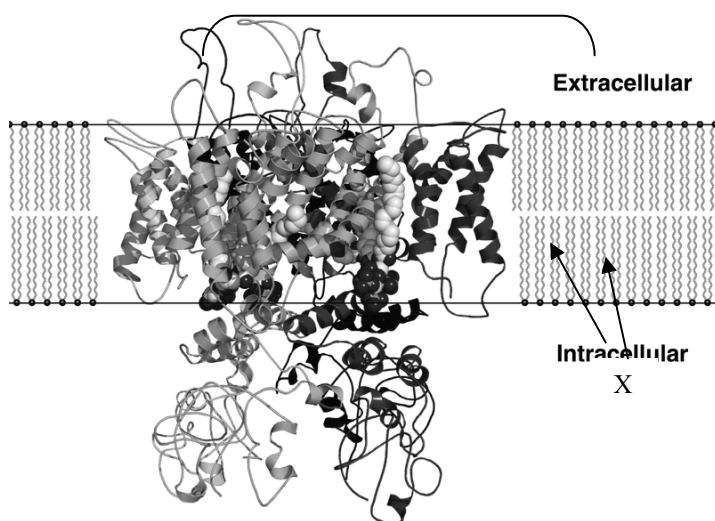


Membrane containing capsaicin

Longitudinal section through a chilli pepper

- a** Why would plants of the genus *Capsicum*, produce capsaicin in their fruit?

(1 mark)



Nociceptors are special sensory neurons in the skin that respond to painful stimuli such as high temperatures and inflammation. Researchers have found that these same neurons respond in the same way to capsaicin. When these nerve cells are activated an ion channel TRPV1 opens to allow the movement of sodium and calcium ions into the cell. Researchers have found that capsaicin causes the release of substance P from the nerve endings.

- b** A sodium ion is a very small ion. Why does it need to cross the cell membrane through the TRPV channel?

(1 mark)

- c** Referring to label X on the diagram, suggest what type of chemical makes up the TRPV1 ion channel.

(1 mark)

- d** How does the action of capsaicin result in the sensation of pain?

(2 marks)

Both temperatures (above 43°C) and the ingestion of chilli peppers activate the same TRPV1 receptor.

- e** How is the result of these two stimuli different?

(1 mark)

Capsaicin has been used in some inflammatory conditions, such as arthritis. Creams, containing capsaicin are rubbed into painful joints and this brings relief from the pain.

- f** Suggest a mechanism for the action of such a cream.

(1 mark)

Total 7 marks

END OF EXAMINATION

Acknowledgements

Websites

http://en.wikibooks.org/wiki/Anatomy_and_Physiology_of_Animals/The_Cell

<http://train-srv.manipalu.com/wpress/?p=92422>

<http://ocw.jhsph.edu/imageLibrary/index.cfm/go/il.viewImageDetails/resourceID/445A72BC-B7B0-DC45-C92E0CB67A53163B/>

<http://en.wikipedia.org/wiki/Methotrexate>

<http://bio1152.nicerweb.com/Locked/media/ch45/neurohormone.html>

<http://www.ncbi.nlm.nih.gov/books/NBK26921/>

<http://en.wikipedia.org/wiki/TRPV1>