

2011 Trial Examination

STUDENT NUMBER

Figures

Words

Letter

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BIOLOGY

Unit 3 – Written examination 1

Reading time: 15 minutes

Writing time: 1 hour and 30 minutes

QUESTION & ANSWER BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
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 permitted in this examination.

Materials supplied

- Question and answer book of 25 pages.

Instructions

- Print your name in the space provided on the top of this page.
- All written responses must be in English.

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

SECTION A – Multiple-choice questions

Instructions for Section A

Select the response that is **most correct** for the question. A correct answer scores 1, an incorrect answer scores 0. Marks are not deducted for incorrect answers. If more than 1 answer is completed for any question, no mark will be given.

Question 1

A person hyperventilates before attempting to swim the length of a pool without breathing. Which of the following is a consequence of hyperventilating?

- A. Blood becomes alkaline
- B. Respiratory rate increases
- C. Enzymes may denature
- D. Haemoglobin is overloaded

Question 2

During the process of translation amino acids are joined together by a:

- A. Catabolism reaction
- B. Condensation reaction
- C. Addition reaction
- D. Hydrolysis reaction

Question 3

Which of the following refers to the tertiary structure of a protein?

- A. The presence of alpha helices
- B. Bonding between 3 polypeptide chains
- C. A sequence of amino acids.
- D. The 3 dimensional folding of the molecule

Question 4

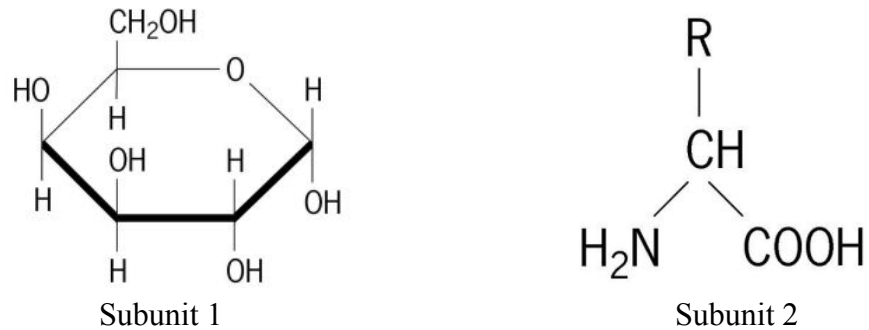
Which of the following is a difference between DNA and RNA?

- A. Uracil is present in DNA and not RNA
- B. DNA is only located in the nucleus, RNA is located in the nucleus and the cytosol
- C. The two types of molecules have different ribose sugars
- D. DNA has a positive charge, RNA has a negative charge

SECTION A - continued

Question 5

The diagram below shows the subunits for 2 different biological molecules.

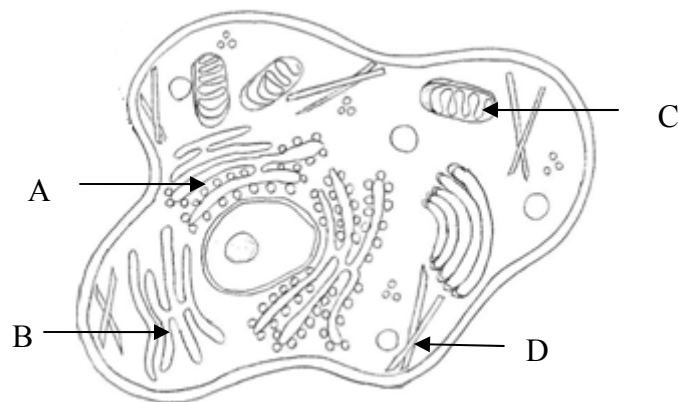


Which of the following correctly identifies subunit 1 and sub unit 2?

- A. Carbohydrate, lipid
- B. Nucleic acid, amino acid
- C. Lipid, carbohydrate
- D. Carbohydrate, amino acid

Question 6

A student draws the following diagram of a cell. Which of the following correctly identifies an organelle with its function?



- A. A protein synthesis
- B. B aerobic respiration
- C. C Photosynthesis
- D. D packaging of molecules

**SECTION A – continued
TURN OVER**

Question 7

Chemical reactions can be used to track the location and extent of chemical reactions within a cell. If a scientist specifically wishes to track the production of proteins, which of the following atoms should be radioactively labelled?

- A. Sodium
- B. Carbon
- C. Nitrogen
- D. Sulphur

Question 8

A short section of a polypeptide was found to contain 15 amino acids. How many mRNA nucleotides would need to be translated to produce this polypeptide segment?

- A. 45
- B. 30
- C. 15
- D. 3

Question 9

A company has just produced a new type of toothpaste which they believe is superior to their previous product. They wish to carry out a study to compare the effectiveness of the 2 types of toothpaste and plan to use a group of people to test the products. Which of the following would be the most correct method to use?

- A. Half of the group use the new toothpaste and the other half do not brush their teeth
- B. Everybody in the group brushes their teeth with the new toothpaste
- C. Everybody in the group brushes their teeth with the old toothpaste and then they brush their teeth with the new toothpaste and see if there are any improvements
- D. Half of the group brush their teeth with the old toothpaste and half with the new toothpaste

Question 10

A patient with kidney failure is placed on a haemodialysis machine to eliminate urea from their blood. Which of the following best explains this process?

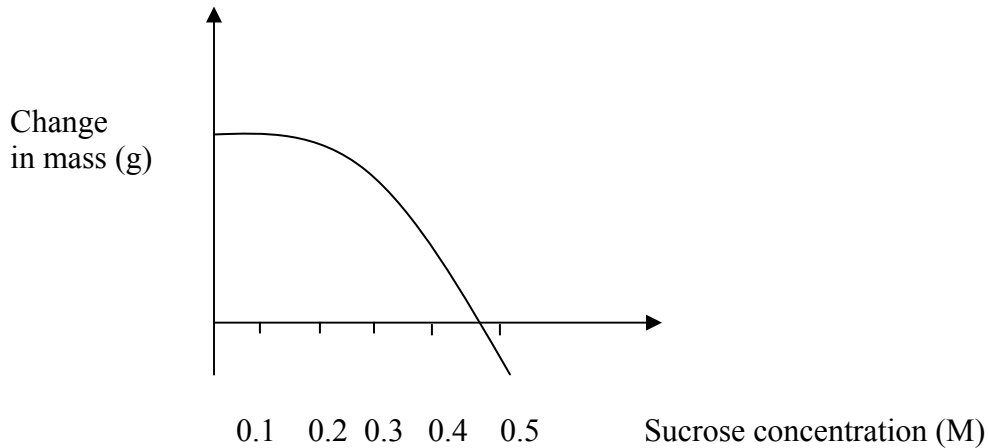
- A. Concentration of urea in the blood and the dialysis fluid is the same
- B. Concentration of water molecules in the blood is higher than that of the dialysis fluid
- C. Concentration of urea in the blood is higher than that of the dialysis fluid.
- D. Concentration of glucose is higher in the blood than in the dialysis fluid.

SECTION A - continued

Question 11

The graph below shows the change in the mass of potato strips against the concentration of a sucrose solution.

Use the information supplied to identify which solution is hypertonic to the potato strips.



- A. 0.2M Sucrose
- B. 0.3M Sucrose
- C. 0.4M Sucrose
- D. 0.5M Sucrose

Question 12

Baby peas are sweet because they have a high sugar concentration. One problem faced by food manufacturers is that the sugars are converted into starch within hours of being picked. The sweetness of the baby peas is preserved by blanching the peas, which involves placing them into boiling water for a short period of time before freezing them.

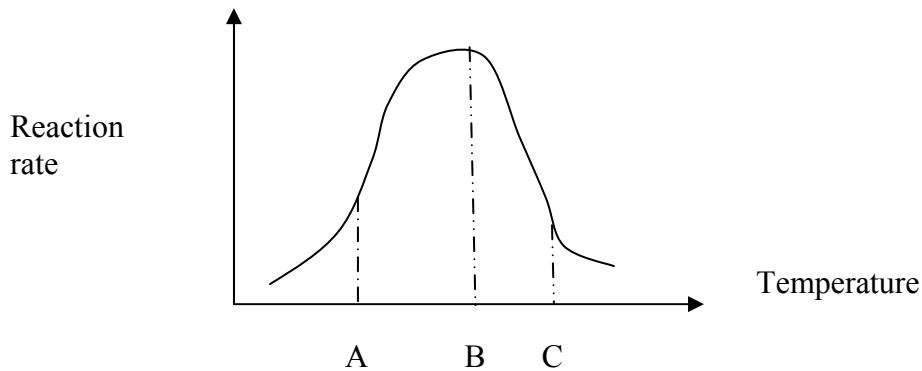
The purpose of blanching the peas is:

- A. Alter the chemical structure of the sugar so that it cannot be broken down
- B. Deactivate the enzymes that are responsible for converting sugars into starch
- C. Break down the chlorophyll in the pea preventing starch from being synthesised
- D. Convert existing starch back into sugar

SECTION A - continued
TURN OVER

Question 13

The diagram below shows the effects of changing temperature on the rate of a reaction catalysed by enzyme Z.



The diagram below shows the shape of the enzyme under optimal conditions



Which of the following shows the most likely shape of the enzyme at temperatures A, B and C?

- | | A | B | C |
|-----------|---|---|---|
| A. | | | |
| B. | | | |
| C. | | | |
| D. | | | |

Question 14

The electron transport chain is one of the processes involved in cellular respiration. Which of the following statements is most correct about the electron transport chain?

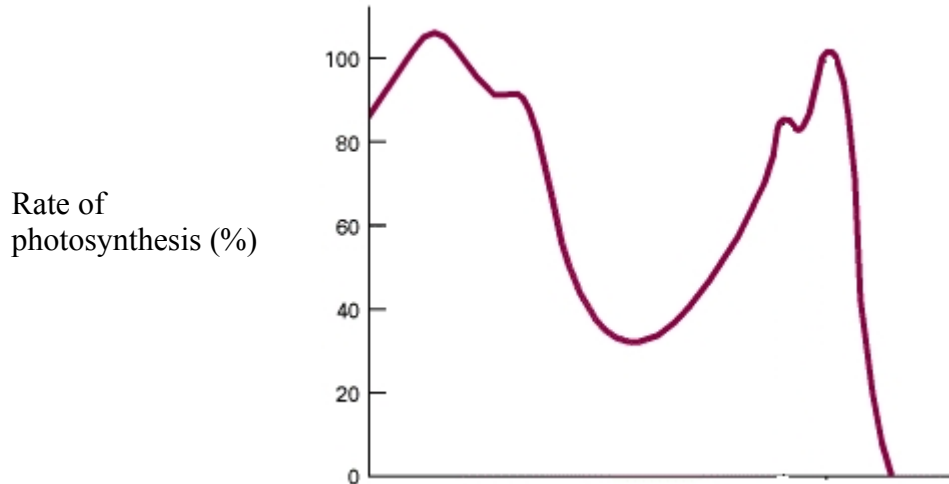
- A.** FADH_2 delivers electrons to the electron transport chain
- B.** Hydrogen ions are the final acceptor
- C.** Acetyl co enzyme A is the source of high energy electrons
- D.** Cytokinins located in cisternae carry electrons along the chain

SECTION A - continued

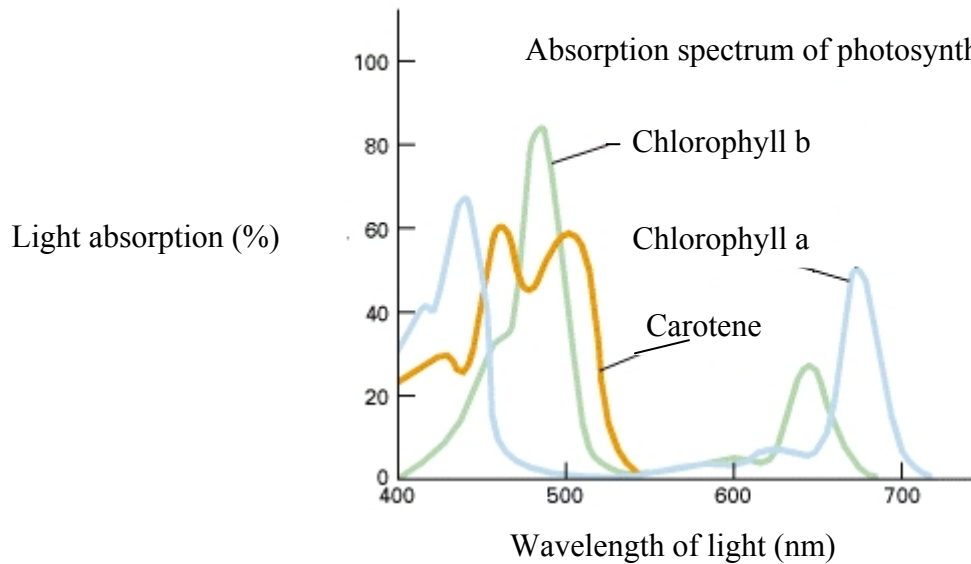
Question 15

The diagrams below show the action and absorption spectra for photosynthesis.

Action spectrum of photosynthesis



Absorption spectrum of photosynthesis



The similarities between the 2 spectra indicate that:

- A. Light absorption is least effective at 400 and 650 nm
- B. Chlorophyll b is the primary pigment for photosynthesis
- C. Carotene is a product of photosynthesis
- D. The rate of photosynthesis is independent of the % light absorption

**SECTION A – continued
TURN OVER**

Question 16

Which of the following information is true for the light dependent and light independent reactions that occur during photosynthesis?

	Light dependent reaction	Light independent reaction
A.	ATP is produced	ATP is not produced
B.	Carbon dioxide in the main input	Water is the main input
C.	The reaction occurs in the stroma	The reaction occurs in the grana
D.	The reaction only occurs during daylight	The reaction only occurs in the lack of daylight

Question 17

ATP is the molecule that is essential for many cellular functions. Which of the following reactions results in a net production of ATP?

- A. Active transport of amino acids
- B. Light dependent stage of photosynthesis
- C. Conversion of glycogen into glucose
- D. Conversion of pyruvate into ethanol and carbon dioxide

Question 18

Cholinesterase is an enzyme that is located on the surface of the post synaptic terminal. This enzyme is responsible for breaking down the neurotransmitter acetylcholine. Certain insect sprays block the action of cholinesterase. The effect of these sprays would be:

- A. The presence of the blocker prevents acetylcholine from diffusing across the membrane
- B. Receptor channels in the post synaptic terminal don't open preventing transmission of the impulse
- C. Acetylcholine builds up at the post synaptic terminal causing action potentials to continue to occur
- D. Acetylcholine cannot be broken down, so the components are unavailable for future use preventing any future action potentials

SECTION A - continued

Question 19

The following is a list of events that occur during the transmission of a nervous impulse.

- I. Neurotransmitters bind to receptors on the postsynaptic terminal
- II. A new electrical impulse is generated
- III. Neurotransmitters are released into the synapse
- IV. An electrical impulse reaches the presynaptic terminal

Which of the following is the correct sequence of events that occur?

- A. IV, III, I, II
- B. I, II, IV, III
- C. III, I, IV, II
- D. II, III, IV, I

Question 20

A signal transduction pathway is activated by a cytoplasmic receptor. Which of the following would have been the initiating signal?

- A. A steroid
- B. A protein hormone
- C. A neurohormone
- D. A neurotransmitter

Question 21

The mirror orchid (*Ophrys speculum*) adopts a female mimic strategy for pollination. It looks like a female digger wasp and secretes chemicals that attract male digger wasps. This is an example of:

- A. A hormone
- B. A receptor
- C. A pheromone
- D. A stimulus

SECTION A - continued
TURN OVER

Question 22

Which of the following is an example of negative feedback?

- A. A person scratches an itch but then becomes more itchy
- B. A persons calf muscles cramp when they remain in one spot
- C. Cows let down milk when calves butt their heads on their udders
- D. When a person is hyperglycaemic, the pancreas is stimulated to produce insulin

Question 23

A person was exposed to a pathogen that causes symptoms rapidly. They are provided with immunity through the transfusion of a serum that contains antibodies that are specific for the pathogen. They are advised that this immunity will only last for a few weeks. This type of immunity is referred to as:

- A. Naturally acquired active immunity
- B. Naturally acquired passive immunity
- C. Artificially acquired active immunity
- D. Artificially acquired passive immunity

Question 24

Cell X plays an important role in the immune system. It has been observed that cell X plays a role in the third level of defence and it matures in the bone marrow. The most likely role of cell X is:

- A. Stimulate NK cells to secrete perforin that destroys pathogens
- B. Stimulate neutrophils to move into affected tissues
- C. Secrete antibodies that bind to antigens
- D. Secrete histamine that binds to IgE antibodies

Question 25

Which of the following statements is most correct regarding the inflammatory response?

- A. Mast cells secrete chemotactic chemicals that attract lymphocytes
- B. The initial stage of the inflammatory response is swelling
- C. Macrophages secrete chemicals that target vascular tissue
- D. Interferon kills bacteria before they are taken up by macrophages

END OF SECTION A

SECTION B - Short-answer questions

Instructions for Section B
Answer all questions in the spaces provided.

Question 1

When concentrations of carbon dioxide in the blood increase, the carbon dioxide reacts with water to form carbonic acid. The carbonic anhydrases are a family of enzymes that catalyse the reversible reaction that converts carbon dioxide and water into bicarbonate ions and protons as shown below.



- a. The anhydrases require zinc ions to be positioned at the active site. Identify the term that is used to describe the role of the zinc ions and explain their purpose.

2 marks

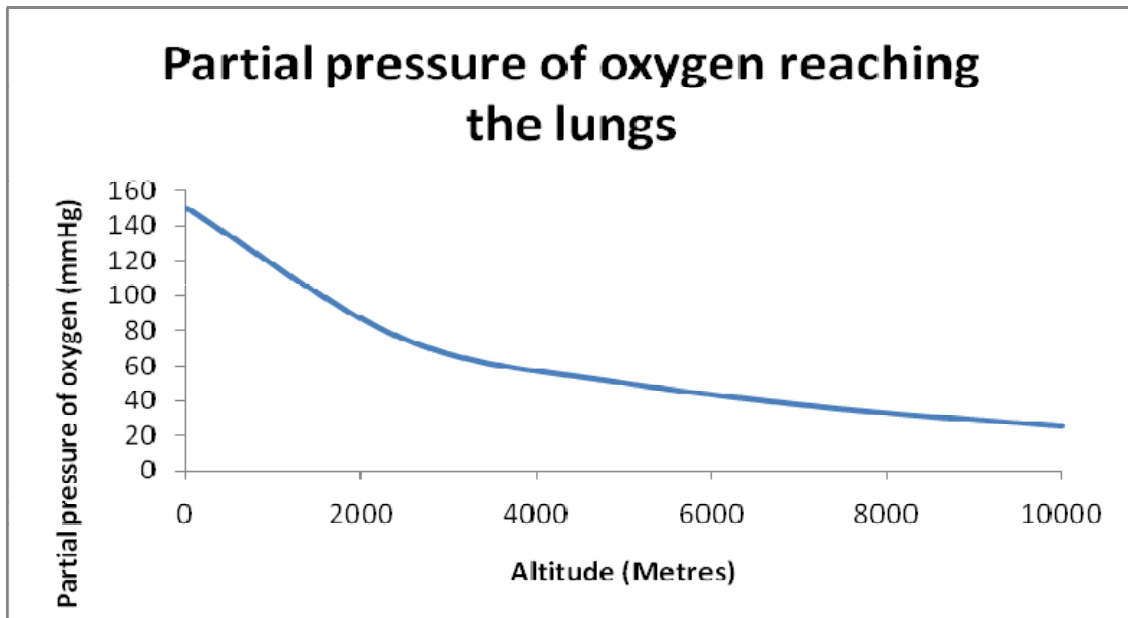
- b. Identify what would happen to blood pH if the concentration of carbon dioxide increased and carbonic anhydrase was not present.

1 mark

SECTION B- Question 1 - continued
TURN OVER

Mountain sickness is a condition that occurs when a person ascends into higher altitudes at a faster rate than their body can adjust to.

The graph below shows the partial pressure of oxygen that reaches the lungs as altitude changes.



- c. An athlete who lives at sea level (0 metres elevation) is planning on competing in an event that will be taking place in a location 2000m above sea level.

Identify what will happen to the amount of oxygen that will reach their lungs compared to the normal amount. Use the data to support your answer.

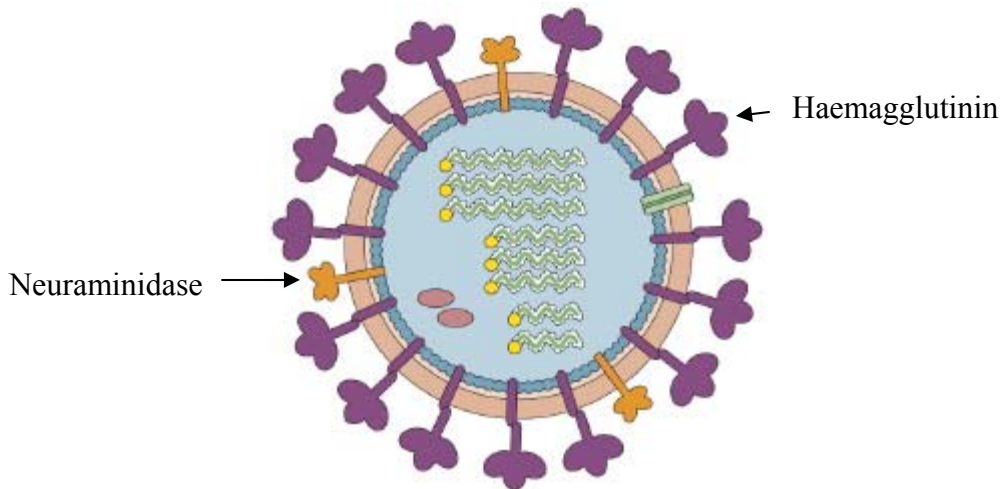
1 mark

- d. The athlete decides to undergo acclimatisation by going to the location 1 month before the event. One of the acclimatisation techniques involves increasing their ventilation rate. Explain why increasing the ventilation rate would cause the athlete to excrete higher than normal levels of bicarbonate ions in their urine.

2 marks
Total 5 marks

Question 2

The influenza virus has 2 different surface proteins that facilitate the viruses ability to cause infections. Haemagglutinin is responsible for enabling the virus to enter a host cell and neuraminidase allows the replicated viral particles to leave the host cell.



SECTION B- Question 2 - continued
TURN OVER

A drug called Relenza has been designed to bind to the active sites of neuraminidase.

a. On the diagram above draw a possible shape for Relenza.

1 mark

b. The development of drugs such as Relenza is an application of proteomics. Define proteomics and explain the link between proteomics and rational drug design.

2 marks

c. The neuraminidase polypeptide consists of a single chain composed of six conserved polar amino acids followed by several variable amino acids. Beta sheets are the predominant shape observed in the molecule. What level of classification do the beta sheets represent? What attributes do beta sheets provide the protein?

2 marks

Total 5 marks

SECTION B- continued

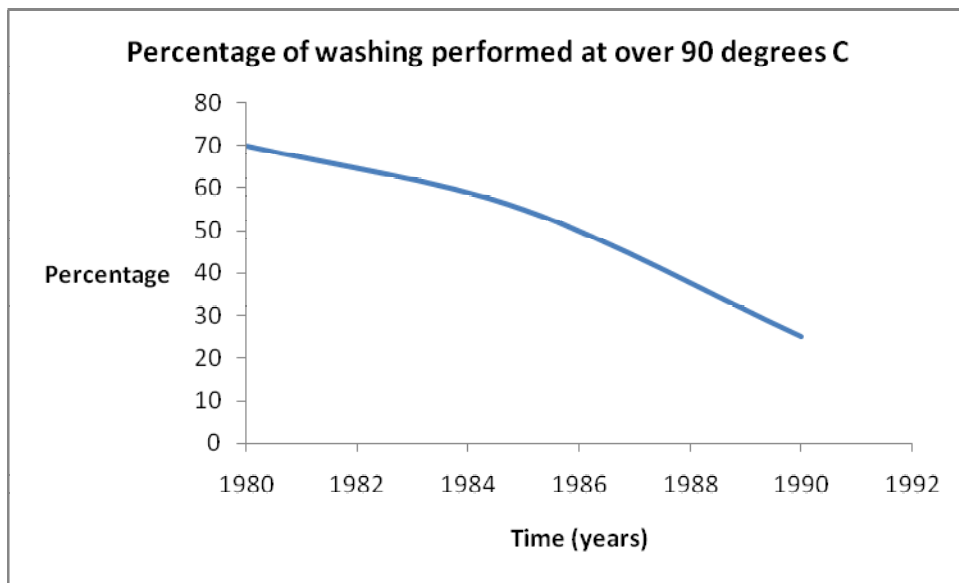
Question 3

The washing detergent industry is the largest purchaser of enzymes in the world. Commonly proteases and amylases are used to remove a wide variety of marks including blood and grass stains. For most detergents enzymes are only present at approximately 0.4% (4g of enzyme per kilo of detergent).

- a. Explain why it is unnecessary for detergents to contain high concentrations of enzymes.

1 mark

The graph below shows the trend in the percentage of loads of clothes washed at temperatures in excess of 90°C over a period of 10 years.



SECTION B- Question 3 - continued
TURN OVER

- b.** The use of hot water has traditionally enabled soaps and detergents to lift stains from clothes. Explain why it has become increasingly necessary to wash clothes in cold water.

2 marks

Currently the most common enzymes used in detergents are proteases and amylases. An early example of a detergent that utilised lipases needed to be withdrawn from the market because it caused cellular damage.

- c.** Identify the most likely location of cellular damage caused by these detergents. Justify your choice.

2 marks

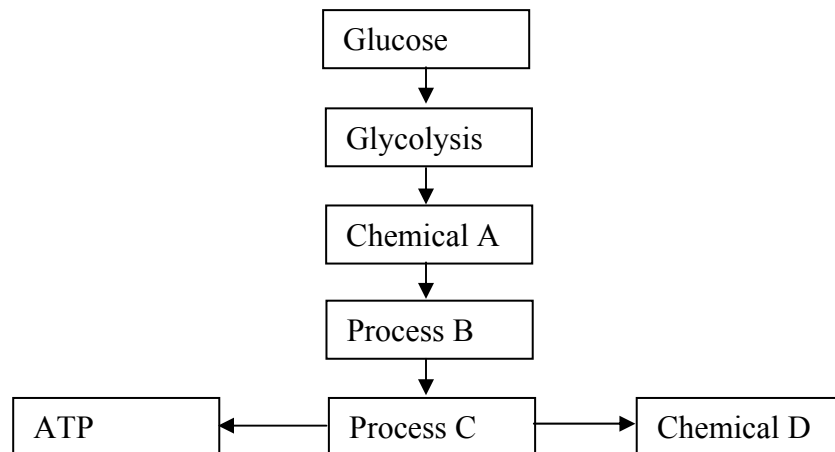
SECTION B- Question 3 – continued

- d. Early attempts to use proteases resulted in hypersensitivity reactions because of microscopic dust located on the surface of the detergent powder particles. What is a hypersensitivity reaction? Identify a possible improvement that could be made to the detergent to prevent these reactions from occurring.

2 marks
Total 7 marks

Question 4

The diagram below represents an overview of cellular respiration.



- a. How many carbon atoms are present in chemical A?

1 mark

SECTION B- Question 4 – continued
TURN OVER

b. Where does process B take place?

_____ 1 mark

c. Process C is involved in the stepwise production of ATP. Explain how energy is produced and identify chemical D.

3 marks
Total 5 marks

SECTION B- continued

Question 5

In 2010 scientists presented a new technique for creating bioartificial organs for transplant patients. This technique involves removing all of the cells from a donor organ leaving just a scaffold. Stem cells from the patient are then applied to the scaffold in order to regrow the organ.

- a. Explain why rejection occurs and why the scientists believe that using these bioartificial organs will reduce the chance of rejection occurring.

3 marks

- b. Identify 2 methods that are currently used to reduce the chance of rejection occurring.

2 marks

- c. Select one of these methods and explain why it reduces the chance of rejection.

1 mark

- d. Identify the cells that act directly against transplanted organs.

1 mark

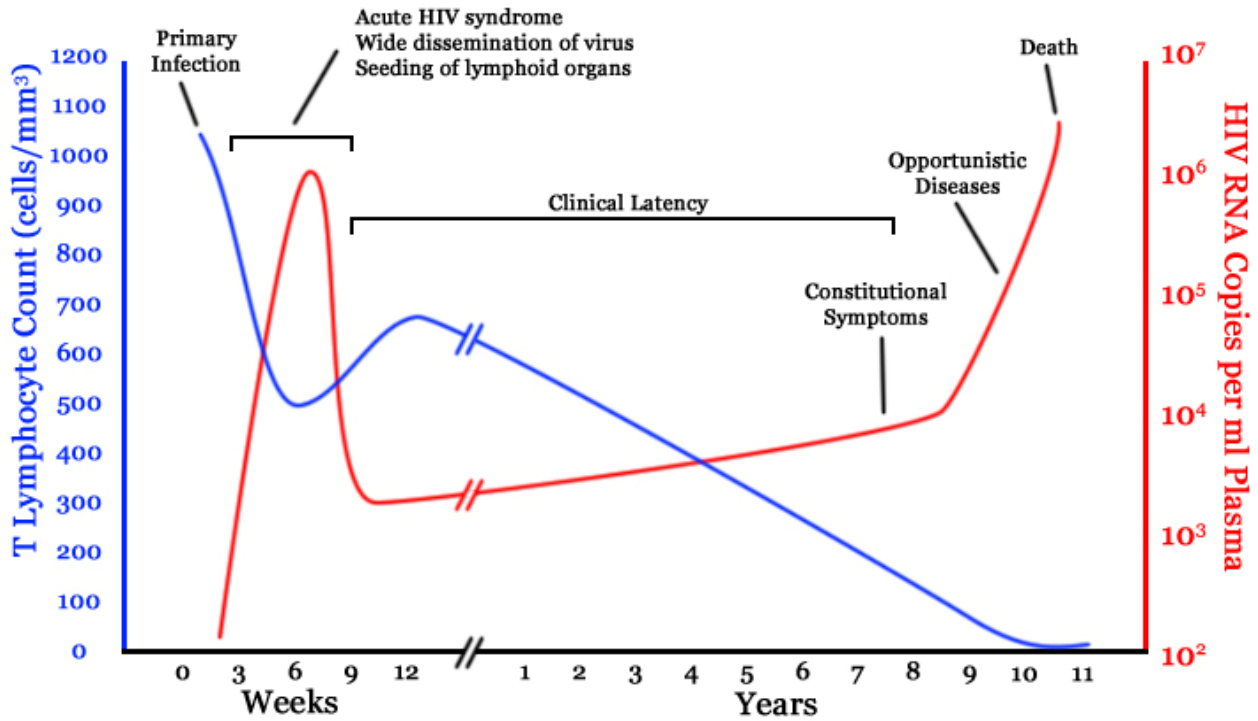
Total 7 marks

SECTION B- continued

TURN OVER

Question 6

People who have been infected with the HIV virus are consistently monitored for the level of HIV particles and T lymphocyte count. The graph below shows a graph of results for a person with HIV.



a. Explain how a virus such as HIV infects cells.

2 marks

b. Explain why doctors are specifically interested in the T lymphocyte count.

1 mark

SECTION B- Question 6 - continued

c. Explain why people with HIV develop opportunistic infections.

2 marks

d. Some vaccines consist of attenuated viruses. What does attenuated mean? Why aren't vaccines with attenuated viruses used to inoculate people against HIV?

2 marks

e. During the first year after infection, the patient consistently complained that they had a sore or swollen throat. Identify the structure that is actually swollen. Why would this occur?

2 marks

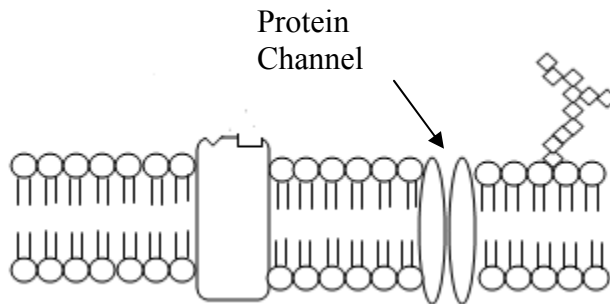
SECTION B- Question 6 – continued
TURN OVER

- f. Humans have three levels of defence that protect them from infection. Identify a possible first level of defence against HIV and explain how the virus is able to bypass this level.

2 marks
Total 11 marks

Question 7

The plasma membrane of an axon has many channels that only allow sodium (Na^+) and potassium (K^+) ions to move through them.



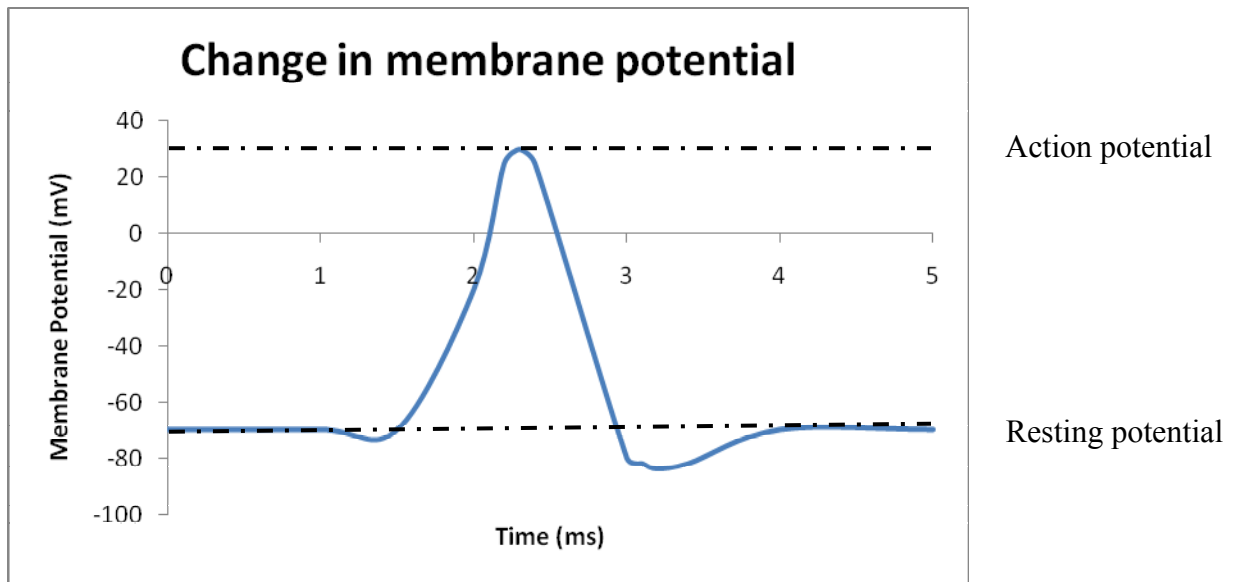
The sodium potassium pump ensures that during a resting potential there are more sodium ions outside the cell than potassium ions inside the cell. At this point the membrane is said to be polarised.

- a. Identify the charge inside and outside the membrane during the resting potential.

1 mark

SECTION B- Question 7 - continued

The graph below shows the change in membrane potential that occurs before, during and after an action potential.



b. Describe what has happened to cause the change in membrane potential between 1.5 and 3.0 ms.

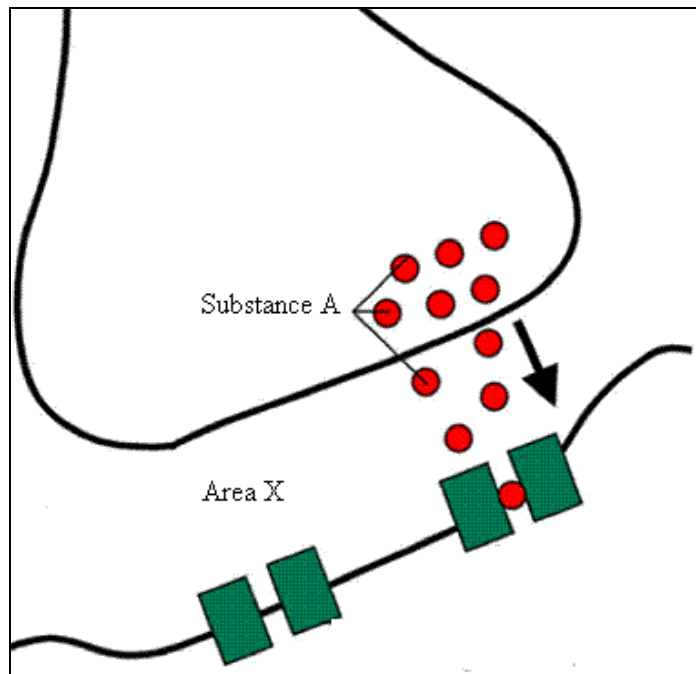
2 marks

SECTION B- Question 7 – continued
TURN OVER

- c. As can be seen on the graph an action potential occurs in approximately 1 millisecond. Explain the importance of the speed of a nervous impulse.

1 mark

The diagram below shows a part of the process that occurs during the transmission of a nervous impulse.



- d. Identify substance A.

1 mark

- e. Identify the process which enables substance A to cross area X.

1 mark

SECTION B- Question 7 - continued

Congenital insensitivity to pain (CIPA) is a rare condition that prevents sufferers from detecting stimuli such as pain and temperature changes. They are also unable to sweat.

- f. Given that people with CIPA are still able to detect weight, pressure and texture, does the problem lay with the peripheral nerves or the central nervous system? Explain.

2 marks

- g. Explain why people with CIPA also have problems with thermoregulation.

2 marks

Total 10 marks

END OF QUESTION AND ANSWER BOOK