

## 2010 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	6	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 permitted in this examination.

#### Materials supplied

- Question and answer book of 23 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.**

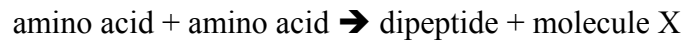
**SECTION A – Multiple-choice question**

**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**

The equation below represents a chemical reaction:



Which of the following is molecule X?

- A. Protein
- B. Water
- C. Nucleotide
- D. Fatty acid

**Question 2**

Which of the following characteristics are common to both bacteria and fungi?

- A. Organisms have a nucleus, cell wall and RNA
- B. Organisms are multicellular and have ribosomes and a plasma membrane
- C. Organisms are unicellular and have mitochondria and a cell wall
- D. Organisms have a plasma membrane, cell wall and DNA

**Question 3**

Which of the following statements regarding protein synthesis is correct?

- A. Transcription uses a DNA template, producing RNA in the cytosol
- B. Translation involves mRNA being read, producing RNA in the nucleus
- C. Translation involves mRNA being read, producing a polypeptide in the cytosol
- D. Transcription uses a DNA template, producing a polypeptide in the nucleus

**SECTION A - continued**

**Question 4**

Which of the following atoms can be used to establish the difference between a nucleic acid and a protein?

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

**Question 5**

A student observes an elodea (an underwater grass like plant) leaf under a light microscope. They then place another elodea leaf into a 10% salt solution and leave it for a period of 15 minutes. Which one of the structures below will be more noticeable in the second leaf compared to the first leaf?

- A. Cell wall
- B. Nucleus
- C. Chloroplast
- D. Plasma membrane

**Question 6**

The tissues of freshwater fish are hypertonic with respect to their environment. Which of the following must occur in freshwater fish to maintain an appropriate concentration of water in their blood?

- A. They must constantly drink large quantities of water
- B. Ions are removed through their gills
- C. They excrete large volumes of dilute urine
- D. They need to actively absorb salt from the water via osmosis

**Question 7**

Identify the products that will be produced when glucose is fermented by yeast.

- A. Alcohol, carbon dioxide and 36 ATP
- B. Alcohol, carbon dioxide and 2 ATP
- C. Lactic acid, carbon dioxide and 2 ATP
- D. Carbon dioxide, water and 36ATP

**SECTION A - continued**  
**TURN OVER**

**Question 8**

During aerobic respiration, before glucose is converted into the final products it must first be converted to:

- A. Lactic acid
- B. Glycogen
- C. Galactose
- D. Pyruvic acid

**Question 9**

Which of the following is the final acceptor in the electron transport chain?

- A. Water
- B. Oxygen
- C. Hydrogen
- D. NADP

**Question 10**

Where does the Krebs cycle occur in animal cells?

- A. Matrix
- B. Cytosol
- C. Cristae
- D. Plasma membrane

**Question 11**

Which of the following statements best refers to the action of enzymes?

- A. They are all able to catalyse many different types of reactions
- B. They increase the activation energy of a chemical reaction
- C. They circulate in the blood stream until required
- D. They are released unchanged after binding to a substrate

**Question 12**

Many enzymes require zinc or magnesium ions in order to catalyse a reaction. These ions are referred to as:

- A. Activators
- B. Cofactors
- C. Coenzyme
- D. Substrates

**SECTION A - continued**

**Question 13**

Which of the structures within a chloroplast capture the light?

- A. Cisternae within the grana
- B. Thylakoids within the grana
- C. Grana within the stroma
- D. Membranes within the stroma

**Question 14**

Which of the following is the reason why light is required during the light dependent stage of photosynthesis?

- A. Light energy causes the production of electrons
- B. Light is directly responsible for splitting water molecules
- C. Light phosphorylates ADP producing ATP
- D. Light provides the energy which energises electrons

**Question 15**

Which part of a neuron do impulses enter through?

- A. Dendrite
- B. Axon
- C. Cell Body
- D. Ganglion

**Question 16**

When threatened, poison dart frogs produce toxins known as Batrachotoxins. The effect of these toxins is to cause an irreversible increase of the permeability of sodium channels, causing them to be permanently active. There is no known antidote for this type of poison. Death occurs shortly after exposure to the poison because:

- A. The influx of sodium causes the cell membrane to remain depolarised
- B. Sodium causes rapid release of neurotransmitters from vesicles
- C. Neurons are unable to secrete neurotransmitters
- D. Muscles are unable to contract

**SECTION A - continued**  
**TURN OVER**

**Question 17**

Which of the following statements regarding the transmission of action potentials is most correct?

- A. Increasing the strength of the stimulus increases the rate of impulse transmission
- B. There must be less sodium ions diffusing into the cell than potassium ions diffusing out
- C. Increasing the diameter of the axon decreases the speed of impulse transmission
- D. Impulse transmission will occur faster through myelinated nerves

*The following information relates to questions 18 and 19*

Bovine spongiform encephalopathy (BSE) also known as Mad Cows Disease is a fatal disease caused by exposure to an unenclosed infectious protein. The cells invaded by the disease causing agent degenerate and die causing the development of holes in the brain.

The first human case was diagnosed in the UK in 1986, and, although the number of cases peaked in 1993, some cases continue to be diagnosed every year.

**Question 18**

Identify the type of agent responsible for causing BSE.

- A. Bacteria
- B. Microbe
- C. Prion
- D. Virus

**Question 19**

In Australia there is a constant demand for blood donors. However, there are a number of reasons why blood may not be accepted. If you lived in the UK between 1980 and 1996 you will not be accepted as a blood donor. Which of the following is the reason for this prohibition?

- A. Blood may contain toxins causing BSE
- B. Blood may contain agents which alter brain structure and function
- C. Blood may contain viral agents capable of causing HIV
- D. Blood cells will be identified as non self and rejected

**Question 20**

After a person has an organ transplant they are given drugs designed to decrease the chance of rejection occurring. Which of the following correctly explains the mode of action of these drugs?

- A. They suppress the immune systems ability to detect foreign antigens
- B. They enable they immune system to produce protective antibodies
- C. They label the transplanted organ with “self” antigens
- D. They suppress the production of cytotoxic T cells

**SECTION A - continued**

**Question 21**

A doctor sees four different patients, each with different conditions and symptoms. Correctly identify which person should be prescribed antibiotics.

- A. Person 1 who has thrush caused by a fungal infection
- B. Person 2 who has hepatitis caused by a viral infection
- C. Person 3 who has typhoid caused by a bacterial infection
- D. Person 4 who has malaria caused by a protozoan infection

**Question 22**

Which of the following is an example of specific immunity?

- A. A helper cell T activating a plasma B cell
- B. A macrophage displaying an antigen on its surface
- C. Interferon inhibiting bacterial reproduction
- D. Interleukins causing a fever

**Question 23**

Rheumatoid arthritis is an autoimmune disease which causes inflammation in the joints of the hands and feet. Which of the following is most likely to cause rheumatoid arthritis?

- A. White blood cells secrete a high concentration of histamine
- B. Cytotoxic T cells fail to recognise joint cells as self
- C. B cells secrete antibodies which damage joint cells
- D. Suppressor T cells cause apoptosis of the joint cells

**Question 24**

When a person is bitten by a poisonous snake the venom travels rapidly through the body via the lymphatic system. Victims are injected with antivenin (also called antivenom) as soon as possible. Antivenins are developed by exposing horses to the venom and subsequently collecting small amounts of their blood. Antivenins are used because:

- A. They already contain the B memory cells that are specific to the venom antigen
- B. They contain attenuated venom toxins which stimulate the production of antibodies
- C. They already contain antibodies which will bind to and neutralise the venom
- D. They contain T helper cells which will activate immature B cells

**SECTION A - continued**  
**TURN OVER**

**Question 25**

Antibodies known as antisera are used to determine blood type. Anti-A binds with the type A antigen on the surface of a red blood cell and Anti-B binds with the type B antigen on the surface of a red blood cell. Binding between the antibodies and the antigens cause clumping known as agglutination. Type A cells have the A antigen, type B cells have the B antigen, type AB cells have both antigens and type O cells have neither. If Anti-B is added to a sample of blood and clumping occurs what is the blood type/s of the blood sample?

- A. Type B only
- B. Type AB or type B
- C. Type O only
- D. Type A or Type B

**END OF SECTION A**



**SECTION B - Short-answer questions**

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

**Question 1**

Insulin is a peptide-based hormone that is composed of 51 amino acids. It is initially produced as a hexamer, a unit of 6 molecules held together by zinc ions. The insulin hexamer is inactive and is much more stable than the active form of insulin, which is in the form of a much smaller monomer.

- a. Identify the highest level of classification present in an insulin hexamer.

\_\_\_\_\_ 1 mark

There are two main forms of diabetes mellitus:

Those with type 1 diabetes are unable to manufacture insulin and obtain it from an external source and then inject it into their bloodstream.

Those with type 2 diabetes are able to produce insulin but their cells are insulin resistant and so they control this condition by diet.

- b. Explain why insulin used to treat type 1 diabetes is stored as a hexamer, but injected as a monomer.

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2 marks

**SECTION B - continued**  
**TURN OVER**

- c. Explain why it is necessary to inject insulin into the blood stream rather than consume it as a tablet.

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2 marks

- d. Explain why hormones such as insulin do not affect all cells.

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1 mark

- e. Identify the processes responsible for the synthesis of insulin.

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1 mark

**SECTION B - continued**

The table below shows the differences in amino acid sequence between bovine, porcine and piscine insulin compared to that of human insulin.

Insulin origin	Number of amino acid differences
Bovine (cow)	3
Porcine (pig)	1
Piscine (fish)	5

- f. A scientist hypothesised that porcine insulin would be the best possible substitute for human insulin. Design an experiment to test this hypothesis.

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3 marks

Total 10 marks

**SECTION B - continued**

**TURN OVER**

**Question 2**

The table below contains information about three different metabolic reactions including the source of carbon, energy and electrons.

METABOLIC REACTION	CARBON SOURCE	ENERGY SOURCE	ELECTRON SOURCE
Aerobic respiration	Glucose	Glucose	Glucose
Anaerobic respiration	Glucose	Glucose	Glucose
Photosynthesis	Carbon dioxide	Light	Chlorophyll and water

- a. Explain why the sources of carbon, energy and electrons are all the same for aerobic and anaerobic respiration while the energy and electron sources for photosynthesis are different to each other.

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2 marks

- b. During glycolysis  $\text{NAD}^+$  is reduced to  $\text{NADH}$ , use the information supplied to identify the source of energy that causes this reaction.

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1 mark

- c. A similar molecule,  $\text{NADP}$  is involved in photosynthesis. What is the role of this molecule?

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1 mark

**SECTION B** - continued

Temperature, carbon dioxide concentration and light intensity are all factors which limit the rate of photosynthesis. The table below shows the effect of temperature and carbon dioxide concentration on the rate of photosynthesis as light intensity increases.

Light Intensity	Rate at high carbon dioxide concentration and 25°C	Rate at high carbon dioxide concentration and 10°C	Rate at low carbon dioxide concentration and 25°C	Rate at low carbon dioxide concentration and 10°C
0	0	0	0	0
1	15	8	2	1
2	60	45	5	3
3	130	80	7	5
4	200	140	10	8
5	220	160	14	11

- d. Identify whether temperature or carbon dioxide concentration have the greatest effect on the rate of photosynthesis. Use the data to support your answer.

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2 marks

**SECTION B - continued**  
**TURN OVER**

- e. Aerobic respiration occurs in the mitochondria and photosynthesis in the chloroplast. Mitochondria have many folds called cristae, while chloroplasts have many thylakoid disks in stacks. Explain the benefit of these structures.

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2 marks

- f. Explain why the rate of photosynthesis decreases when temperature decreases.

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2 marks

Total 10 marks

**SECTION B - continued**

**Question 3**

Oxytocin is a hormone that is manufactured in the hypothalamus and released into the blood through the posterior pituitary gland. It is a peptide hormone consisting of nine amino acids.

One of the roles of oxytocin is to regulate the “let down” reflex in breast feeding mothers. When the baby begins to suckle muscles surrounding milk ducts in the breasts contract, causing milk to flow.

The availability of milk enables the child to continue suckling setting up an action potential which results in the production of more oxytocin.

- a. What term is used to describe hormones such as oxytocin which are secreted by the central nervous system?

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1 mark

- b. Identify the type of feedback occurring in this example. Justify your response.

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2 marks

**SECTION B - continued**  
**TURN OVER**

c. Describe the mechanism of signal transduction for oxytocin.

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2 marks

d. In the space below draw a stimulus/response diagram showing the action of oxytocin.

3 marks  
Total 8 marks

**SECTION B - continued**



**Question 4**

The Human immunodeficiency virus (HIV) is a retrovirus that causes a condition known as acquired immunodeficiency syndrome (AIDS). This virus targets macrophages and T helper cells leaving those affected vulnerable to opportunistic infections which would normally be harmless.

- a. Identify a first line of defence against viral infections.

\_\_\_\_\_ 1 mark

- b. Although plants are not affected by HIV, they are susceptible to viral infections. Identify one mechanism by which plants are able to protect themselves against infection by a virus.

\_\_\_\_\_ 1 mark

- c. Identify one method of transmission of the HIV virus.

\_\_\_\_\_ 1 mark

- d. Use your knowledge of specific immunity to explain why people with AIDS are particularly vulnerable to opportunistic infections.

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\_\_\_\_\_ 2 marks

**SECTION B - continued  
TURN OVER**

There are several different types of vaccines that can be produced to combat viral infections. One type of vaccine contains live, attenuated particles.

e. Define the term “attenuated”.

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1 mark

f. Explain why it would not be possible to develop an attenuated vaccine for HIV.

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2 marks

Total 8 marks

**SECTION B - continued**

**Question 5**

All substances foreign to the body have surface antigens. Hypersensitivity is the condition of being overly sensitive to an antigen known as an allergen. Common allergens include peanuts, pollen and soy protein.

- a. Briefly explain how the immune system is able to identify a substance as foreign.

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1 mark

- b. There are two different types of immunity; innate and adaptive. Is a hypersensitivity reaction part of the innate immune system or the adaptive immune system? Justify your response.

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2 marks

**SECTION B - continued**  
**TURN OVER**

- c. Explain the role of mast cells and histamine in a hypersensitivity reaction.

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2 marks

- d. It is not uncommon for people to experience a hypersensitivity reaction without being aware of the cause. One of the methods used to identify the allergen is the skin prick test which involves pricking the skin with a small amount of a variety of allergens. Briefly explain the purpose of this test and identify what would occur if a person is sensitive to a particular allergen.

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2 marks

- e. A hypersensitivity reaction cannot occur unless an individual is sensitised to an allergen. Explain what this means.

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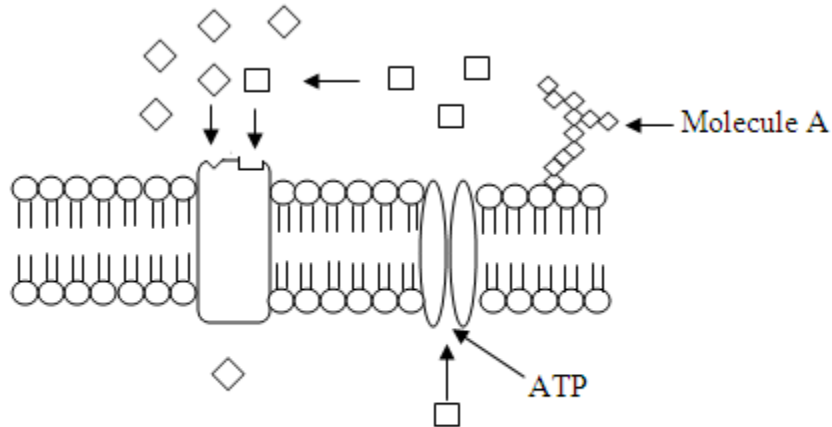
1 mark  
Total 8 marks

**SECTION B - continued**  
**TURN OVER**

**Question 6**

The diagram below represents a section of a plasma membrane with an ion pump in operation.

The ion pump enables the transport of hydrogen ( $H^+$ ) ions from the cytosol to the extracellular fluid. The  $H^+$  ions then diffuse back into the cell enabling the transport of glucose molecules.



Key:       $\diamond$  Glucose Molecule       $\square$   $H^+$  Ion

- a. Identify molecule A and identify a function of this molecule.

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2 marks

**SECTION B** - continued

- b. Identify the type of material transport responsible for transporting glucose into the cell. Justify your response.

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2 marks

- c. Explain what will happen to the internal concentration of glucose if the internal concentration of  $H^+$  ions increases.

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2 marks

Total 6 marks

**END OF QUESTION AND ANSWER BOOK**