

## 2017 Trial Examination

STUDENT  
NUMBER

--	--	--	--	--	--	--	--

Letter

--

# BIOLOGY

## Unit 3 – Written examination

Reading time: 15 minutes

Writing time: 1 hour and 30 minutes

### QUESTION AND 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 20 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**

Answer all questions of the Multiple Choice Answer Sheet provided

**Question 1**

The fluid mosaic model refers to structure of the plasma membrane. It is so called because:

- A. the membrane consists of a phospholipid bilayer which contains highly mobile phospholipid molecules and proteins embedded throughout the membrane, some of which are able to move
- B. the membrane consists of a phospholipid bilayer, with all proteins embedded in a fixed position throughout the membrane
- C. the membrane consists of hydrophilic heads and hydrophobic tails
- D. the membrane separates the internal and external cellular environments

**Question 2**

There are a number of different proteins embedded in the plasma membrane. Which of the following shows the correct combination of name and function of the membrane proteins?

- A. Receptor proteins – link cells together to build the three dimensional structure of tissues
- B. Adhesion proteins – form a channel through the membrane to enable polar molecules to cross the membrane
- C. Glycoproteins – enable cell-cell communication
- D. Transport proteins – bind to hydrophilic molecules to activate a secondary messenger and initiate a cellular response

**Question 3**

What is the function of cholesterol in the plasma membrane?

- A. At high temperatures, it disrupts the intermolecular bonding between the phospholipid tails, increasing membrane fluidity
- B. At low temperatures, it increases cross-linking between the hydrophobic tails, increasing stability
- C. It regulates fluidity of the plasma membrane at high and low temperatures
- D. It is hydrophobic, and therefore allows movement of non-polar molecules across the membrane

**SECTION A - continued**

**Question 4**

Which of the following substances are unable to pass through the hydrophobic region of the plasma membrane?

- A. water, oxygen, amino acids
- B. ethanol, carbon dioxide, glucose
- C. chloride ions, glucose, carbon dioxide
- D. sodium ions, nucleotides, glucose

**Question 5**

Which of the following processes occur in the nucleus?

- A. transcription of DNA to produce mRNA
- B. modification of polypeptides, such as by the addition of carbohydrate groups
- C. synthesis of polypeptides from amino acids
- D. assembly of amino acids to enable DNA replication

**Question 6**

When comparing the functions of the rough endoplasmic reticulum and the Golgi apparatus, it is correct to say that:

- A. proteins are assembled in the rough endoplasmic reticulum and are modified for export in the Golgi apparatus
- B. proteins are assembled in the Golgi apparatus and are modified for export in the rough endoplasmic reticulum
- C. polypeptides are modified in the rough endoplasmic reticulum, and are folded and assembled in the Golgi apparatus
- D. polypeptides are synthesised in the rough endoplasmic reticulum and are chemically labelled for export in the Golgi apparatus

**Question 7**

In reference to protein structure and synthesis, it is correct to say that:

- A. the sequence of amino acids in the polypeptide is the secondary structure of the protein
- B. a protein has a tertiary structure when different polypeptides bind together
- C. a hydrolysis reaction occurs between amino acids, resulting in a polypeptide
- D. hydrophobic regions would group together in the centre of the protein, hydrophilic regions would be on the exterior

**SECTION A - continued  
TURN OVER**

**Question 8**

When comparing DNA and RNA, it is expected that

- A. DNA has uracil instead of thymine, RNA has thymine instead of uracil.
- B. DNA strands are aligned in an antiparallel arrangement, RNA molecules can have different folding arrangements
- C. The ribose sugar on RNA has one less oxygen atom than DNA
- D. The amount of thymine in a DNA strand is equal to the amount of uracil in an RNA strand of the same length.

**Question 9**

When a repressor protein is removed from a regulatory gene:

- A. Transcription of the corresponding structural gene will commence, but translation will not occur to produce the polypeptide
- B. neither transcription of the structural gene nor translation will take place
- C. transcription of the corresponding structural gene will start, followed by translation to produce the polypeptide
- D. transcription will be prevented so that the cell does not waste resources

**Question 10**

With regard to cellular metabolism which of the following is correct:

- A. the production of ATP from ADP + Pi is anabolic and exergonic
- B. the breakdown of glucose to produce carbon dioxide occurs via a condensation reaction
- C. in metabolic pathways, the product of one reaction is often the substrate for the next
- D. the production of ATP from ADP + Pi is catabolic and endergonic

**Question 11**

Carbonic anhydrase is present in the blood plasma to catalyse the conversion of carbon dioxide and water to carbonic acid and bicarbonate ions. Carbonic anhydrase has a  $Zn^{2+}$  ion associated with its active site. In respect to carbonic anhydrase, it is true that:

- A.  $Zn^{2+}$  is a cofactor that enables the enzyme to work more efficiently
- B. the conversion of carbon dioxide and water to carbonic acid and bicarbonate ions will only occur in the presence of carbonic anhydrase
- C. this reaction will only occur in one direction
- D. the carbonic anhydrase increases the activation energy for the reaction

**SECTION A** - continued

**Question 12**

ATP synthesis occurs during which of the following stages of biochemical reactions?

- A. In the light dependent and light independent stages of photosynthesis, and during the Krebs' cycle of respiration only
- B. During glycolysis, the light independent reaction of photosynthesis and the Krebs' cycle
- C. The light dependent stages of photosynthesis, glycolysis, the Krebs' cycle and the electron transfer chain
- D. During glycolysis and the Krebs' cycle only

**Question 13**

Cell fractionation can be used to separate the organelles in a cell. The cells are homogenized, then placed in an ultracentrifuge. They are spun at high speed, and each time the heaviest parts sink to the bottom. The pellet is removed each time, and the cell contents are re-spun.

The successive pellets from each spin are as follows:

Pellet 1: nuclei and cellular debris

Pellet 2: mitochondria, lysosomes

Pellet 3: fragments of ER, small vesicles

Pellet 4: ribosomes and macromolecules, including large proteins

Cytochromes are proteins found involved in the electron transport chain. After cell fractionation, they would be found in:

- A. Pellet 1
- B. Pellet 2
- C. Pellet 3
- D. Pellet 4

**Question 14**

Cortisone is a steroid hormone released during times of stress. It prepares the body for a fight or flight response, including causing vasodilation of blood vessels to skeletal muscles. In regard to cortisone, which of the following is correct?

- A. It is hydrophilic in nature
- B. The hormone causes a reduction in heart rate
- C. The hormone binds to a receptor, activating a secondary messenger which in turn starts a protein cascade
- D. Cortisone binds to intracellular receptors to initiate a cellular response

**SECTION A - continued  
TURN OVER**

**Question 15**

Which of the following are an example of a plant growth regulator?

- A. insulin
- B. auxins
- C. cytokines
- D. neurotransmitter

**Question 16**

In order to set up the resting potential in an axon, which of the following is correct?

- A. sodium ions are actively pumped out of the axon, and potassium ions are actively pumped in
- B. the sodium-potassium pump moves more potassium ions into the membrane than sodium ions out of the axon
- C. sodium ions are actively pumped out of the axon, potassium ions follow by facilitated diffusion
- D. the myelin sheath is permeable to sodium ions, but not potassium ions

**Question 17**

When glucose is detected in high concentrations within the blood stream, the  $\beta$ -cells in the Islets of Langerhans are stimulated to produce insulin. The insulin binds to protein kinase receptors on liver cells, which activates the signal transduction pathway. This results in the activation of the enzyme which causes glycogen to be built from glucose molecules. In regards to this sequence of events:

- A. reception occurs when the insulin binds to the protein kinase receptors
- B. transduction is the activation of the enzyme
- C. the response is the stimulation of the  $\beta$ -cells to produce insulin
- D. the response causes blood glucose levels to increase

**Question 18**

Which of the following is would result in the death of the cell via necrosis rather than apoptosis?

- A. viral infection of a cell
- B. destruction of cells during development
- C. damage to cellular DNA
- D. damage to the cell due to trauma

**Question 19**

Which of the following are pathogenic organisms?

- A. viruses, bacteria, protozoa
- B. protozoa, bacteria, fungi
- C. prions, fungi, parasites
- D. viroids, bacteria, protozoa

**Question 20**

Chemical defences of organisms to prevent pathogenic entry include:

- A. keratinised skin
- B. stomach acid
- C. cilia lining airways
- D. ear wax

**Question 21**

A patient is suffering from the early stages of breast cancer. Part of the body's response to this includes:

- A. NK cells recognise the altered MHC markers on the tumour cells, initiating cellular destruction
- B. recognition of the tumour cells as non-self, so launching a specific immune response
- C. binding of antibodies to mast cells, to stimulate the release of histamine
- D. activation of B memory cells to produce antibodies to the tumour cells.

**Question 22**

Which of the following is NOT a phagocytic white blood cell?

- A. Monocytes
- B. Neutrophils
- C. Macrophages
- D. B-plasma cells

**Question 23**

Humoral immunity is part of the specific immune response. The immune cells involved in humoral immunity include:

- A. T-helper cells, B-plasma cells and B-memory cells
- B. T-helper cells, cytotoxic T cells and B-memory cells
- C. T-helper cells, phagocytes and B-plasma cells
- D. T-helper cells, B-plasma cells, B-memory cells and cytotoxic T cells

**SECTION A – continued  
TURN OVER**

**Question 24**

During an immune response, different types of antibodies are produced. IgM antibodies are produced as a rapid response to infection, while IgG antibodies are produced later. Only IgG antibodies are able to cross the placenta. During pregnancy, a mother contracts a mild form of *Salmonella* food poisoning. After birth, it would be expected that:

- A. the baby does not test positive for any antibodies
- B. the baby demonstrates artificial passive immunity and will test positive for IgG antibodies
- C. the baby will be able to produce its own IgG antibodies
- D. the baby demonstrates natural passive immunity and will test positive for IgG antibodies

**Question 25**

In an allergic response:

- A. An allergen causes mast cells to produce antibodies. These cause the release of histamine, which causes swelling and inflammation
- B. An allergen causes immature B cells to undergo clonal expansion to produce antibodies which bind to mast cells. If the allergen is encountered again, it will bind to the antibodies resulting in the secretion of histamine from the mast cells
- C. An allergen causes the activation of mast cells, resulting in the release of histamine which causes swelling and inflammation
- D. An allergen causes T-helper cells to release histamines, which results in swelling and inflammation

**END OF SECTION A**



**SECTION B - Short-answer questions**

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

**Question 1 (8 marks)**

A student carries out an investigation on transport across a membrane. She creates a liposome, an artificial vesicle which contains only phospholipids arranged in a phospholipid bilayer, and investigates the transport of substances across the membrane. She then compares this to transport across the membrane of a skin cell.

- a.** Identify one similarity and one difference between the membrane structure of the liposome and the membrane structure of a typical animal cell

---

---

---

---

2 marks

- b.** Discuss the differences between ion movement and the movement of small uncharged molecules across the membrane of the skin cell

---

---

---

---

2 marks

**SECTION B – Question 1 – continued**  
**TURN OVER**

2017 BIOLOGY EXAM

The student set up two petri dishes containing a solution that had a high concentration of sodium ( $\text{Na}^+$ ) and chloride ( $\text{Cl}^-$ ) ions. In one petri dish she placed samples of the (intact) liposomes, and in the other she placed some skin cells. She left the dishes for 20 mins, then measured the internal contents of the liposomes and cells.

She found that the intracellular concentration of  $\text{Na}^+$  and  $\text{Cl}^-$  ions had increased in the sample with skin cells, but not in the sample with the liposomes.

- c. Use your knowledge of membrane transport to explain these results.

---

---

---

---

2 marks

- d. She also noticed that in both samples the liposomes and cells had shrunk in size. Explain why this occurred, and whether this would be expected in both samples

---

---

---

---

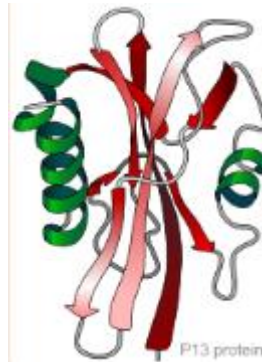
2 marks

Total 8 marks

**SECTION B** – continued

**Question 2 (11 marks)**

A protein was isolated from a cell and its structure analysed using computer technology. A computer generated diagram showing its structure is shown below.



- a. On the diagram identify a region showing each type of secondary structure and give their specific names.

2 marks

- b. What is meant by the phrase “primary structure of a protein”?

---

---

1 mark

**SECTION B – Question 2 – continued**  
**TURN OVER**

c. Describe the sequence of events in transcription and translation that led to the production of the primary structure of the protein.

---

---

---

---

---

---

---

---

---

---

4 marks

		Second Letter				
		U	C	A	G	
1st letter	U	UUU   Phe UUC   UUA   Leu UUG	UCU   Ser UCC   UCA   UCG	UAU   Tyr UAC   UAA   Stop UAG   Stop	UGU   Cys UGC   UGA   Stop UGG   Trp	U C A G
	C	CUU   CUC   Leu CUA   CUG	CCU   Pro CCC   CCA   CCG	CAU   His CAC   CAA   Gln CAG	CGU   CGC   Arg CGA   CGG	U C A G
	A	AUU   AUC   Ile AUA   AUG   Met	ACU   Thr ACC   ACA   ACG	AAU   Asn AAC   AAA   Lys AAG	AGU   Ser AGC   AGA   Arg AGG	U C A G
	G	GUU   GUC   Val GUA   GUG	GCU   Ala GCC   GCA   GCG	GAU   Asp GAC   GAA   Glu GAG	GGU   GGC   Gly GGA   GGG	U C A G

- d. A table of codons is shown above. Identify the primary structure of an amino acid if a sequence of DNA on the template strand is:

**TAC TTA CCA AAA CTC GTT GTG**

---



---

2 marks

**SECTION B – Question 2 – continued  
TURN OVER**

- e. How would the protein formed change if a mutation occurred, changing the fourth nucleotide from a T to an A? Explain why this change occurs.

---



---



---



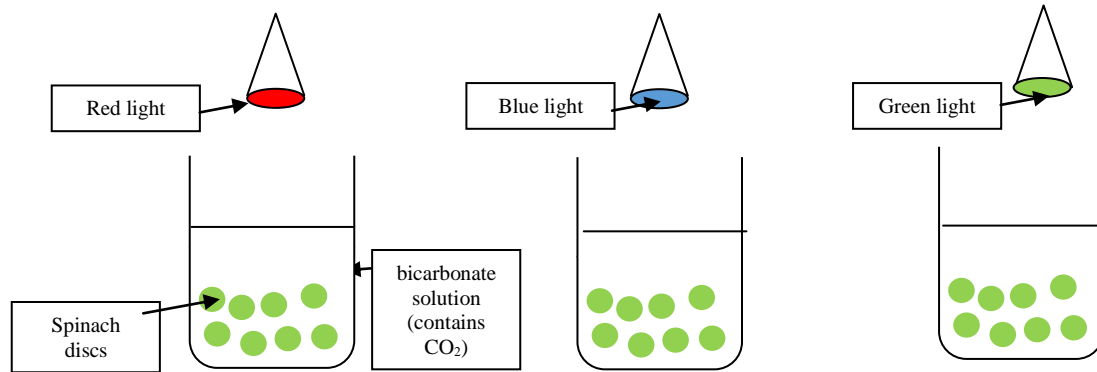
---

2 marks

Total 11 marks

**Question 3**

A scientist carries out an investigation into how different wavelengths of light affect the rate of photosynthesis. She takes small discs of spinach and removes the air from them using a syringe. These are then placed into beakers with bicarbonate solution (a source of carbon dioxide) and exposed to either green, red or blue light, as show below. She leaves them for 10 minutes and counts the number of discs that have risen every minute.



- a. Why does the rate of rising of the leaf discs allow the scientist to determine the extent of photosynthesis?

---



---

2 marks

**SECTION B – Question 3 – continued**

b. Write a suitable hypothesis for this experiment. Explain your hypothesis.

---

---

---

---

2 marks

c. What would be a suitable control for this experiment?

---

1 mark

d. This experiment relies on one of the stages of photosynthesis occurring correctly. Identify this stage and state what is produced as a result of this stage.

---

---

---

---

2 marks

e. The scientist predicted that the levels of glucose produced by the cells in each experiment would be the same. Is she correct? Explain your reasoning.

---

---

---

---

2 marks

Total 9 marks

**SECTION B – continued**

**TURN OVER**

**Question 4**

A synapse is the gap between neurons.

- a. Describe the sequence of events that allows this synapse to transmit an impulse to the next neurone

---

---

---

---

---

---

---

---

3 marks

- b. Outline the process of reception, transduction and response in reference to a synapse.

---

---

---

---

---

---

---

---

3 marks

**SECTION B – Question 4 – continued**



2017 BIOLOGY EXAM

Snakes such as mambas are able to produce powerful venom. The venom contains a chemical that is similar in shape to acetylcholine, and binds to the receptors. A bite from these snakes can result in rapid onset of muscle paralysis and eventual death.

- c. State what kind of inhibitor the snake venom contains and explain why this leads to paralysis and death.

---

---

---

---

2 marks  
Total 8 marks

**SECTION B – continued**  
**TURN OVER**

**Question 5**

Apoptosis is important in ensuring the correct development of an organism. The protein hormone Tumour necrosis factor alpha (TNF $\alpha$ ) is thought to be an important molecule in this process. When this hormone binds to the receptor it activates a series of different pathways that initiate cell death.

- a.** Explain how the binding of TNF $\alpha$  can that initiate cell death.

---

---

---

---

2 marks

- b.** Describe the sequence of cellular responses that bring about apoptosis.

---

---

---

---

3 marks

Total 5 marks

**SECTION B – continued**

**Question 6**

*Streptococcus pneumonia* is a bacterial pathogen that infects the lungs. It is inhaled through the airways and reproduces in the lungs. It can cause symptoms such as coughing, fever, chest pain and breathlessness.

- a. Identify two defences that the body to prevent infection by this bacterium?

---

---

---

---

2 marks

- b. Once inside the lungs, the bacteria are recognised as foreign. How does the body distinguish between self and non-self cells?

---

---

---

---

2 marks

- c. An immediate immune response is launched against the bacteria. Describe two aspects of this immediate response.

---

---

---

---

2 marks

**SECTION B – Question 6 – continued**  
**TURN OVER**

**d.** A number of days after the initial infection, the patient’s blood is sampled and they are found to have high levels of antibodies against this antigen. Describe the sequence of events that led to high levels of specific antibodies circulating in the blood.

---

---

---

---

---

---

---

3 marks

Total 9 marks

**END OF QUESTION AND ANSWER BOOK**