



## 2022 Trial Examination

THIS BOX IS FOR ILLUSTRATIVE PURPOSES ONLY

STUDENT  
NUMBER

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# BIOLOGY

## Unit 3 – Written examination

Reading time: 15 minutes

Writing time: 1 hour and 30 minutes

### QUESTION 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	5	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 permitted in this examination.

#### Materials supplied

- Question and answer book of 16 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.

Choose the response that is 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 student observed a diagram of single stranded nucleic acid and determined that it was DNA. A piece of evidence that would support this is the presence of:

- A. uracil
- B. a deoxyribose sugar
- C. a methyl cap and a poly A tail
- D. anticodons

**Question 2**

The genetic code is considered redundant as:

- A. all organisms are coded for by the same nucleotides
- B. multiple codons code for the same amino acid
- C. all nucleotides are double ringed purines
- D. it is not required for all cell functioning

**Question 3**

Following transcription, the non-coding sections of pre-mRNA are removed. These sections are:

- A. codons
- B. exons
- C. exons
- D. introns

**Question 4**

The functional level of a protein is usually determined by the:

- A. primary structure
- B. secondary structure
- C. tertiary structure
- D. quaternary structure

**SECTION A- continued**

**Question 5**

The trp operon is essential in enabling bacteria to produce the amino acid tryptophan when there is none within the immediate environment. To produce tryptophan, the RNA polymerase must bind to the:

- A. regulatory gene
- B. operator region
- C. promoter region
- D. structural genes

**Question 6**

Enzymes speed up chemical reactions that would otherwise occur too slowly to sustain life. One example of an enzyme driven reaction is photosynthesis, as the enzyme Rubisco allows for efficient carbon fixation. The active site of Rubisco is:

- A. identical to the substrate
- B. complementary to the product
- C. identical to the product
- D. complementary to the substrate

**Question 7**

Transport of proteins within the cell occurs from the:

- A. ribosome
- B. endoplasmic reticulum
- C. Golgi apparatus
- D. secretory vesicle

**Question 8**

Recombinant plasmids are used to transfer nucleic acid between different organisms. To maintain the structural integrity of the plasmid, the phosphodiester bonds of the backbone must be reformed. This is catalysed by:

- A. RNA polymerase
- B. DNA polymerase
- C. ligase
- D. ATP synthase

**SECTION A- continued  
TURN OVER**

**Question 9**

CRISPR-Cas9 differs from traditional restriction enzymes, such as EcoRII as:

- A. it creates both sticky and blunt ends
- B. it does not have a set recognition site
- C. the recognition site is palindromic
- D. it can cut any type of nucleic acid

**Question 10**

Gel electrophoresis can be used to identify paternity or for forensic analysis. An assumption made in the analysis of a gel electrophoresis band is that:

- A. the charge of the current will not affect the distance travelled
- B. more porous gels move faster than non-porous gels
- C. smaller fragments travel further than larger fragments
- D. DNA has a positive charge, and it attracted to the negative terminal

**Question 11**

Human insulin can be harvested in bacterial cells through the use of recombinant plasmids. How would a laboratory determine that the transformation of the bacteria had been successful?

- A. the bacteria can grow colonies on agar
- B. the bacteria replicate more rapidly
- C. the bacteria can be observed under a fluorescent light
- D. the bacteria grow in the presence of an antibiotic

**Question 12**

A canola crop had a gene coding for an omega 3 fatty acid, derived from bacteria, inserted into its genome. Individuals who ate the canola gained the benefit of increased omega 3 fatty acids, such as healthier membranes. The characteristic of DNA that allowed this to occur is that the DNA code is:

- A. universal
- B. redundant
- C. degenerate
- D. transferable

**Question 13**

Photosynthesis and cellular respiration are key biochemical processes. In a plant cell, when the rate of photosynthesis and cellular respiration is equal:

- A. the net output of oxygen is zero
- B. the net output of carbon dioxide is zero
- C. the net output of glucose is zero
- D. the net output of water is zero

**SECTION A-** continued

**Question 14**

The loaded co-enzymes in cellular respiration include:

- A. NADPH, ATP and  $\text{FADH}_2$
- B. NADH,  $\text{ADP} + \text{P}_i$  and  $\text{H}_2\text{O}$
- C. NADH, ATP and  $\text{FADH}_2$
- D. NADPH, ATP and  $\text{P}_i$

**Question 15**

ATP synthase is a key enzyme in the electron transport chain. A molecule bound to ATP synthase, altering the shape of the active site so that the substrate could no longer bind is an example of:

- A. competitive inhibition
- B. non-competitive inhibition
- C. saturation
- D. limiting factor

**Question 16**

Which of the following is true of  $\text{C}_3$  plants?

- A. water is split in the light independent stage on the thylakoid membranes
- B. carbon dioxide enters the grana during the light dependent stage
- C. oxygen is released during the light independent stage
- D. ATP is produced in the light dependent stage

**Question 17**

During photosynthesis, carbon dioxide becomes concentrated in  $\text{C}_4$  plants in the:

- A. bundle sheath cells
- B. xylem
- C. stroma
- D. mesophyll

**Question 18**

A student was observing plant leaves under the microscope, and noticed that on some leaves, the stomata were sunken. It is likely that this plant is classified as a:

- A.  $\text{C}_3$  plant
- B.  $\text{C}_4$  plant
- C. CAM plant
- D. fungi

**SECTION A – continued**  
**TURN OVER**

**Question 19**

During glycolysis, ATP is produced from the breakdown of glucose in the cytosol. The total ATP produced is:

- A. a net production of 4 ATP
- B. a net production of 32 ATP
- C. a total production of 4 ATP
- D. a total production of 2 ATP

**Question 20**

Fermentation of grapes is used in agriculture to produce wine. The bottles are tightly sealed, and make a noticeable 'pop' when opened, with bubbles forming throughout the liquid. The bubbles are due to:

- A. oxygen being produced in the electron transport chain
- B. carbon dioxide and lactic acid being produced
- C. carbon dioxide being produced in the breakdown of glucose
- D. the splitting of water in the light dependent stage of photosynthesis

**Question 21**

In the absence of oxygen, cells:

- A. undergo the Krebs cycle until oxygen becomes available again
- B. undergo glycolysis in the mitochondrial matrix
- C. wait until oxygen becomes available
- D. undergo glycolysis in the cytosol of the cell

**Question 22**

An experiment was conducted to determine the effect of heat on aerobic cellular respiration. Five sets of mitochondria suspended in cytosol were exposed to temperatures of 0°C, 20°C, 40°C, 60°C and 80°C. All other variables remained the same.

One way that the rate of aerobic respiration could be measured is to:

- A. measure the decrease in carbon dioxide
- B. measure the decrease in oxygen
- C. measure the decrease in water level
- D. measure the increase in glucose concentration

**SECTION A-** continued

**Question 23**

CRISPR-Cas9 was used to modify the genome of a C3 plant to make Rubisco have a lower affinity to oxygen. This would:

- A. increase the rate of photosynthesis in the light dependent reaction
- B. decrease the rate of photosynthesis in the light dependent reaction
- C. increase the rate of photosynthesis in the light independent reaction
- D. decrease the rate of photosynthesis in the light independent reaction

**Question 24**

The difference between a first-generation and second-generation biofuel is:

- A. a first-generation biofuel is from food crops, a second-generation biofuel is from non-food crops
- B. a first-generation biofuel is from agriculture, a second-generation biofuel is from horticulture
- C. a first-generation biofuel produces ethanol, a second-generation biofuel produces biodiesel
- D. a first-generation biofuel uses the process of distillation, a second-generation biofuel uses the process of fermentation

**Question 25**

Biofuels are an alternative to traditional energy sources that are finite, such as fossil fuels. Which of the following is an implication that should be considered with the use of biofuels?

- A. excess carbon dioxide will be produced through the fermentation pathway
- B. not everyone will have access to biofuels
- C. contamination from other products mixed with the initial fuel source
- D. all the above

**END OF SECTION A  
TURN OVER**

**SECTION B: Short-answer questions**

**Instructions for Section B**

Answer all questions in the spaces provided.

**Question 1** (14 marks)

All living organisms contain DNA, and it is often described as a universal molecule. In eukaryotes, DNA is tightly wound around histones to create linear chromosomes that are contained within the nuclear membrane.

- a.** DNA is composed of a series of nucleotides, joined to create a strand. What are the subunits of this monomer?

3 marks

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- b.** The backbone of a DNA molecule contains phosphodiester bonds, whereas the bonds between complementary nucleotides are hydrogen bonds. Compare the strength of these two types of bonds and describe how they facilitate their function.

3 marks

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**SECTION B - continued**



**c.** DNA is described as universal. Outline the steps in creating a recombinant plasmid, and how the universal characteristic of DNA enables this to occur.

6 marks

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**d.** The genetic code for insulin is inserted into bacterial plasmids. Following the creation of this recombinant plasmid, explain how the success of the transformation could be measured.

2 marks

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

**Question 2** (9 marks)

Thyroid stimulating hormone (TSH) is produced in the pituitary gland, a small pea shaped gland found in the brain. TSH is responsible for regulating the release of hormones from the thyroid, including regulation of metabolism and heart contractions. As people age, the mass of the thyroid significantly decreases. TSH is a protein-based hormone, synthesised at the ribosome. TSH is produced in the pituitary gland and exported to target cells within the thyroid.

**a.** Describe the process and the role of the organelles involved in the way by which proteins exit the cell.

4 marks

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**b.** Within the nucleus, the genetic code for the protein is converted from DNA into pre-mRNA. Explain three changes that occur to pre-mRNA that allow for efficient gene expression .

3 marks

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**SECTION B** - continued

c. The first stage of protein synthesis involves the production of pre-mRNA in the nucleus. Describe a similarity and a difference between the role of pre-mRNA and tRNA

2 marks

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**Question 3** (10 marks)

Photosynthesis occurs in all plants and converts inorganic materials into organic materials.

a. State the name of one co-enzyme involved in photosynthesis and the role that it plays in enabling photosynthesis to occur.

2 marks

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

**b.** FADH is a co-enzyme used in the Kreb's cycle of aerobic respiration. Why is FADH considered a co-enzyme, and not an enzyme?

2 marks

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**c.** In the colder months the rate of photosynthesis decreases, however in summer when temperature increases, the rate of photosynthesis also increases.  
Explain how temperature affects the rate of photosynthesis.

3 marks

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**SECTION B** --continued

**d.** Limiting factors prevent the rate of a given reaction from continually increasing. Competitive inhibitors also alter the rate of reaction.

Explain how the action of a limiting factor, such as carbon dioxide availability in photosynthesis, differs from the action of a competitive inhibitor in altering the rate of a reaction.

3 marks

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**Question 4** (10 marks)

**a.** Bioethanol and biodiesel are 2 biofuels produced from biomass. For biomass to be converted into a usable energy source for commercial use a series of steps must occur.

Complete the following table outlining what occurs at each step of the bioethanol production.

4 marks

Step	Key Events
Pre-treatment	
Enzymatic hydrolysis	
Fermentation	
Distillation and purification	

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

**b.** Describe how the following conditions would affect the efficiency of the production of bioethanol.

2 + 2 + 2 = 6 marks

**(i)** Temperature

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**(ii)** Substrate availability

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**(iii)** Oxygen

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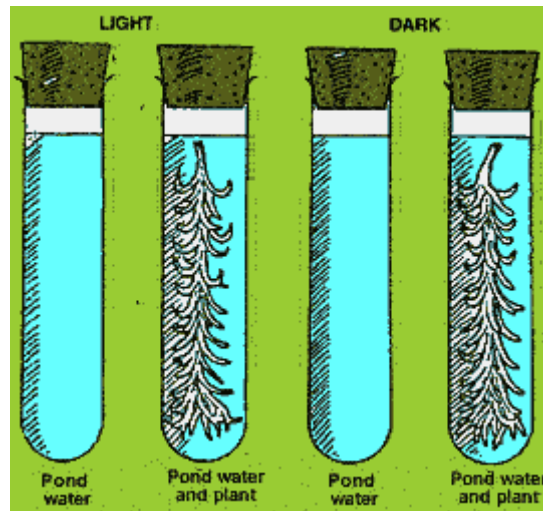
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**SECTION B - continued**

**Question 5** (7 marks)

A student conducting a test to measure the rate of photosynthesis in elodea set up the following test tubes.



From their research, they identified:

- When carbon dioxide levels in the water increase the pH decreases.
- When carbon dioxide levels in the water decrease the pH increases.

They placed the first two test tubes under a lamp, and the last 2 test tubes were covered in foil. Indicator solution was added to each test tube to measure change in pH. Both tests were kept in their condition for 24 hours and all other factors were kept the same.

**a.** What is the purpose of the test tubes without elodea?

1 mark

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

**b.** Assuming that both tests had an initial neutral pH, predict, with reference to the relevant biochemical process, the change in pH for the test tube in the light, and the test tube in the dark.

4 marks

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**c.** Suggest an improvement to this experiment that would improve the accuracy of the results obtained.

2 marks

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**END OF QUESTION BOOK**