



Candidate Name

Candidate Number

Centre Name

Centre Number


**Paper 1: Biology**

(2 hours)

**For Examination December 2023**

It is necessary to respond on the answer sheets provided alongside this question paper. Additionally, you must have a soft pencil (preferably of type B or HB), a clean eraser and a dark blue or black pen.

**INSTRUCTIONS:**

- You must write your name, candidate number, centre name and centre number on the answer sheets in the designated spaces.
- Objective section consists of 25 questions, and it is essential that you attempt all of them.
- Each question has four options labelled A, B, C, and D. Select the option that you think is correct. Mark it on the multiple-choice answer sheet using a soft pencil.
- Attempt all the questions from subjective section using a dark blue or black pen.
- It is important to follow the instructions provided on the answer sheets.
- Do not use correction fluid.
- Avoid writing on any bar codes.

**INFORMATION:**

- This paper has a total of 100 marks.
- In objective section there are 25 questions, each carries one mark. There is no negative marking for incorrect responses.
- In subjective section, 45 marks are for extended theory and 30 marks for practical component.
- The number of marks assigned for every question or its parts is indicated within brackets [ ].

1. Nitrogen is an inert gas, but essential element in many aspects of it is absorbed via the roots of plants in a soluble form. Which of the following substances do not contain nitrogen in their chemical structure.

A: Chlorophyll  
 B: DNA  
 C: Transport proteins  
 D: Cell walls

2. Which one of the following is a monomer?

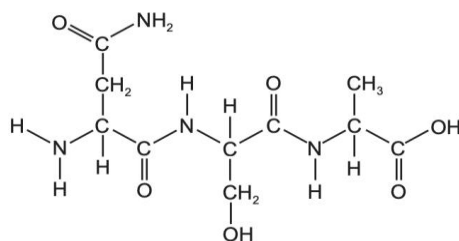
A: Sucrose  
 B: Lactose  
 C: Galactose  
 D: Maltose

3. Starch is a polymer, which of the following are present in starch?

1. Amylose
2. Amylopectin
3. 1-4 glycosidic bonds
4. 1-6 glycosidic bonds
5. Alpha glucose

A: 1, 3 and 5  
 B: 1,2,3 and 5  
 C: 2, 4 and 5  
 D: All the above

4. The diagram shows a protein:



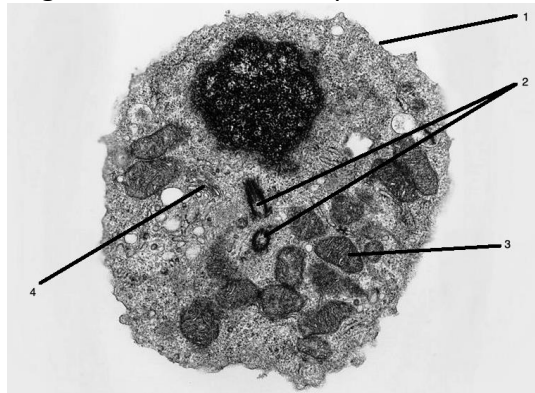
Which row correctly represents the hydrolysis of this molecule:

	Number of peptide bonds	Number of water molecules needed	Number of monomers produced
A	2	2	3
B	3	2	3
C	2	2	2
D	3	3	2

5. Which statement is correct for phospholipids?

- A: They contain 1 ester bonds
- B: They are non-polar molecules
- C: They contain hydrocarbon chains that may be saturated or unsaturated
- D: They contain 3 phosphate molecules bonded to glycerol

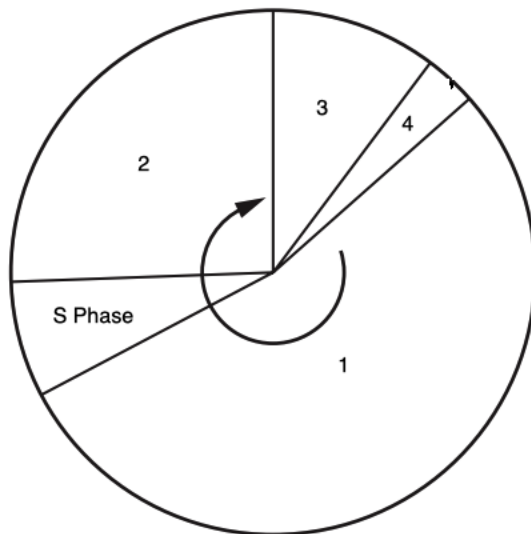
6. Below is an image using an electron microscope:



Which structures labelled identify this as a eukaryotic cell?

- A: 1, 2, and 4
- B: 1 and 2
- C: 2, 3 and 4
- D: 2 and 3 only

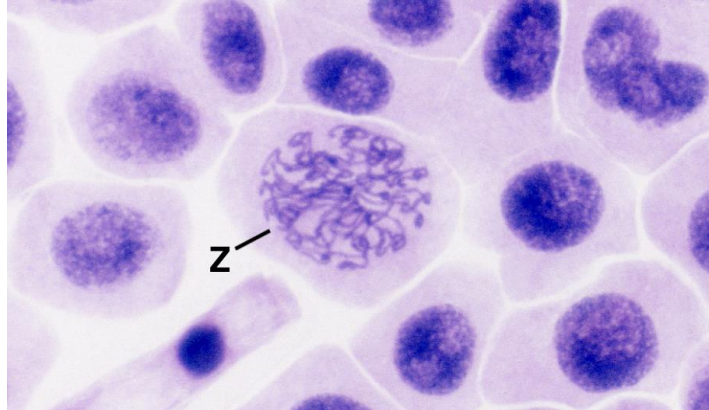
7. The diagram shows the mitotic cell cycle:



During which phases does organelle replication occur?

- A: 3 and 4
- B: 1 only
- C: 2 only
- D: 1 and 2

8. Which part of the cell cycle is being observed from the image below of cell Z?



- A: Interphase
- B: Metaphase
- C: Prophase
- D: Anaphase

9) Following the digestion of a carbohydrate into glucose in the small intestine, which processes can occur to absorb glucose into the blood stream in the small intestine.

1. Simple diffusion
2. Facilitated diffusion via a carrier protein.
3. Facilitated diffusion via a channel protein.
4. Osmosis
5. Active transport

- A: 1, 2 and 3
- B, 2, 3 and 5
- C: 1, 2, 3 and 5
- D: 2,3,4 and 5

10) Which of the following factors increases permeability of cell membranes?

1. Increase in ethanol concentration.
2. Decrease in temperature to 0 degrees C.
3. Increase in temperature above 45 degrees.
4. Containing only saturated fatty acid chains.
5. Containing more unsaturated fatty acid chains

- A: All the above
- B: 1,3 and 5
- C: 1, 2, 3 and 4
- D: 1, 3 and 4

11) Pneumothorax is a condition whereby air flows into the pleural cavity during inhalation and cannot escape causing the lung to not be able to inflate properly. Which of the following is the main reason why a person becomes breathless if pneumothorax occurs?

- A: Volume of thorax cannot be increased
- B: Oxygen partial pressure decreases
- C: Increased vital capacity
- D: Oxygen partial pressure increases

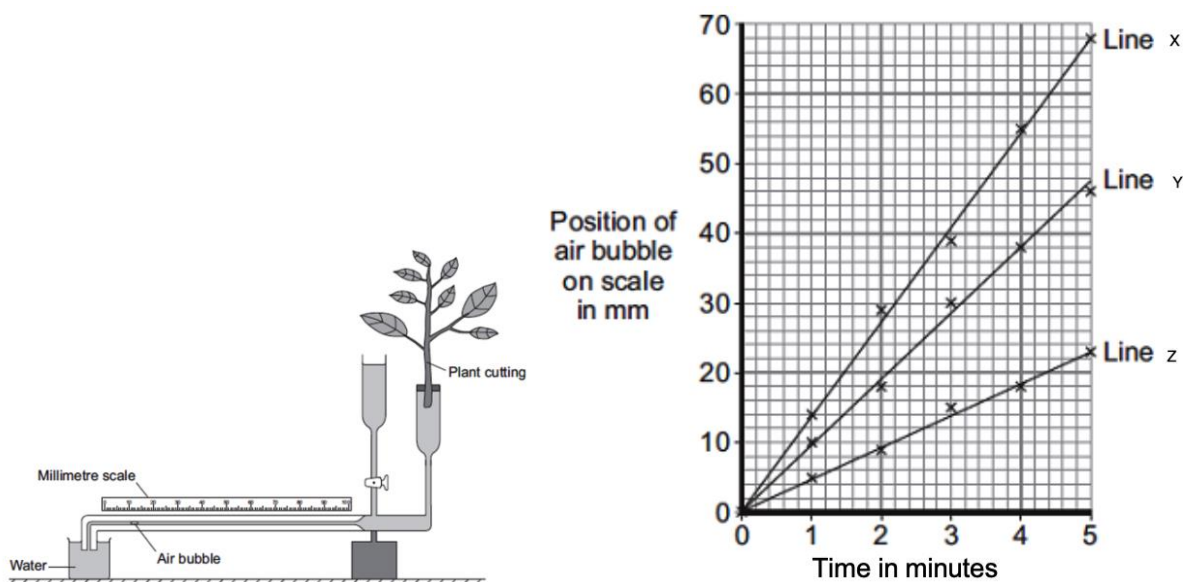
12) Which row correctly describes the coronary vein?

	Thickness of muscle	Elastic tissue	Blood carried	Relative Glucose concentration
A	Thin	Thin	Deoxygenated	Low
B	Thick	Thick	Oxygenated	High
C	Thick	Thin	Oxygenated	Low
D	Thin	Thick	Deoxygenated	High

13) The cycle of opening and closing of stomata is depends on environmental conditions, which of the following best describes stomata behaviour at 12:00pm?

	Stomata	Guard cells	CO <sub>2</sub> in leaf tissue	Soil water
A	Closed	Turgid	Low	High
B	Closed	Flaccid	High	Low
C	Open	Flaccid	High	High
D	Open	Turgid	High	Low

14) Using a potometer to measure the rate of transpiration the equipment was setup like the diagram below:



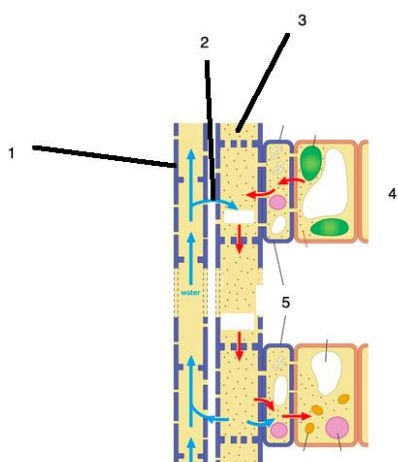
Which is the mostly like cause of the observation of line Z?

- A: Decrease in humidity
- B: Increase in temperature
- C: Increase in humidity
- D: Increase in light intensity

15) Water moves into plants via the roots, which of the following correctly describes the symplastic pathway to get to the xylem?

- A: Cell wall > Epidermis > Plasmodesmata > cortex > endodermis > pericycle > xylem
- B: Cell wall > Casperian strip > endodermis > pericycle > xylem
- C: Cell wall > Epidermis > Plasmodesmata > Casperian strip > endodermis > pericycle > xylem
- D: Cell wall > cell membrane > endodermis > pericycle > xylem

16) More complex plants require a transport system to ensure delivery of the correct substances around their body to carry out various metabolic processes.



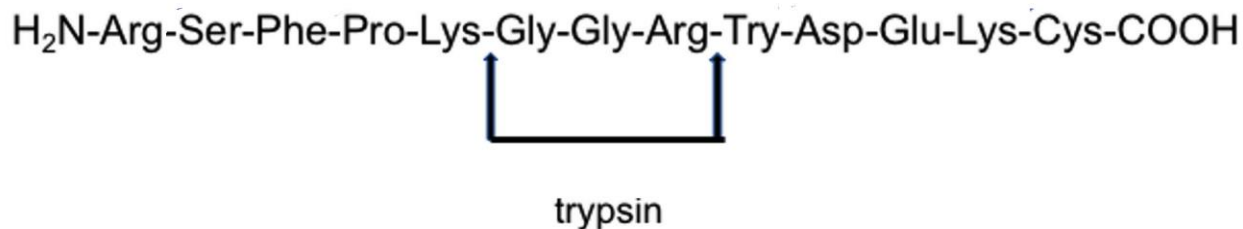
Correctly identify the numbered structures and processes of the plant transport diagram.

	1	2	3	4	5
A	Xylem	Osmosis	Translocation	Source	Companion cell
B	Phloem	Diffusion	Transpiration	Sink	Companion cell
C	Xylem	Osmosis	Translocation	Source	Sieve tube elements
D	Phloem	Active transport	Transpiration	Sink	Phloem cells

17) What is the role of bile salts in micelle formation?

- A: Bile salts are involved in cholesterol formation to give rigidity to the micelle.
- B: Bile salts act as an emulsifier to breakdown large lipid molecules into fatty acids and glycerol.
- C: Bile salts act as an emulsifier to breakdown large lipid droplets into small ones.
- D: Bile salts do not play a role in micelle formation

18) Trypsin an important enzyme in the chemical digestion of protein, the diagram below shows the action of trypsin on a polypeptide.



Which is the correct description of trypsin?

- A: Polypeptidase
- B: Exopeptidases
- C: Aminopeptidase
- D: Endopeptidases

19) Where in the alimentary canal are you likely to find membrane bound “brush border” enzymes?

- A: Stomach
- B: Pancreas
- C: Large intestine
- D: Small intestine

20) Which one of the following cells can produce antibodies?

- A: T cells
- B: B cells
- C: Macrophages
- D: Neutrophils

21) Which one of the following characteristics of the light chain constant region of an antibody?

- A: It is the same for all antibody molecules
- B: It is the region that determines the class of antibodies
- C: It is the region that determines the specificity of an antibody
- D: It is the region that binds to antigens.

22) Which one of the following is an example of artificially acquired passive immunity?

- A: Vaccination
- B: Transfer of maternal antibodies to fetus
- C: Exposure to pathogen and subsequent recovery
- D: Administration of immune serum globin



23) Which one of the following is not a role of histones?

- A: They provide stability to the DNA molecule
- B: They assist in gene regulation
- C: They assist in DNA repair
- D: They can bind to specific regions of DNA

24) The *Loxophlebia nomia* is a prey species that has undergone evolution of mimicry. This has resulted in the appearance more dangerous and less palatable to predators.



(*Loxophlebia nomia*)

Which type of selection can result in the evolution mimicry?

- A: Disruptive selection
- B: Stabilizing selection
- C: Directional selection
- D: Artificial selection

25) Chimpanzees and bonobos are closely related species; bonobos are only found on the southern side of the Congo river.



Which one of the following is unlikely to be correct statement?

- A: They share a recent common ancestor
- B: Proteins produced between bonobos and chimpanzees will have similar amino acid sequences
- C: Genetic drift can contribute to some of differences DNA between bonobos and chimpanzees
- D: Bonobos and chimpanzees are the product of sympatric speciation

Extended theory:

1. Biological molecules are essential for the functioning of organisms. They form the building blocks of all life and essential for their growth, maintenance, and their reproduction.
- a) Complete the table with (✓) to show which elements are found and (X) to show which are not found in the following biological molecules.

Biological molecules	Element				
	Carbon	Nitrogen	Oxygen	Phosphorus	Sulfur
Cellulose					
Triglycerides					
mRNA					
Sucrose					
ATP					
Insulin					

(4)

- b) Phospholipids play an important role in cell surface membranes structurally due to their chemical nature.

With the inclusion of a labelled diagram, describe and explain how phospholipids are arranged in a cell surface membrane? [4 marks]

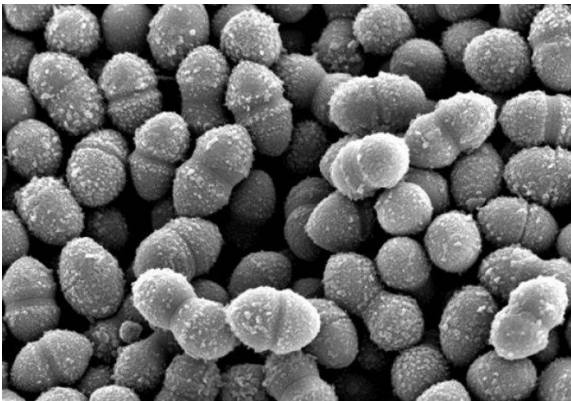
- c) Lipids are an essential part of a human diet, describe a suitable chemical test for the presence of lipids in a food sample? [2 marks]
- d) Water is another essential biological molecule it is believed that without water life would not exist on Earth.

Explain the properties of water that make it essential to support life of organisms. [5 marks]

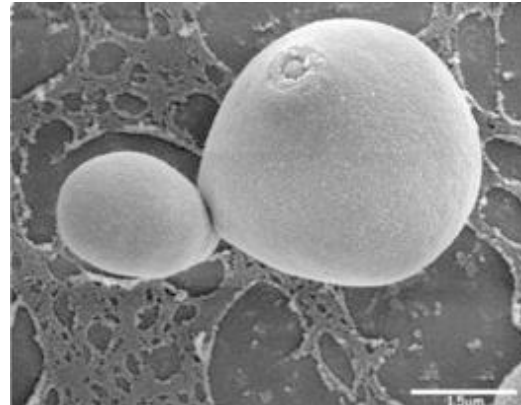
[Total 15 marks]

2) All living organisms are made of cells.

Slide A: Streptococcus A



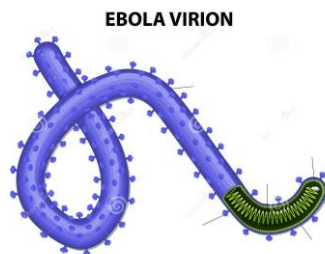
Slide B: Candida albicans



- a) What type of microscope was used to produce these images, explain your answer. [1 mark]

Both species observed in images above are pathogenic. Streptococcus A are bacterial cells whilst Candida albicans is an example of a fungus.

- b) Contrast structures found in Streptococcus and Candida albicans? [3 marks]
- c) Reproduction is an essential life process, both species carry out asexual reproduction. Compare and contrast the processes of asexual reproduction carried out by both organisms. [4 marks]
- d) Ebola is a virus; it is also another example of a pathogen.



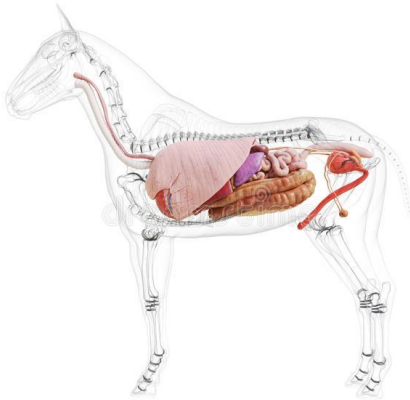
- di) What is the name given to the reproductive cycle of a virus? [1 mark]

Following the infection of a human cell, A single strand of Ebola DNA is made, followed by the addition of a complementary strand, this process is like normal DNA replication in eukaryotes.

- dii) Describe the how the complementary strand of DNA is made? [3 marks]

[Total 12 marks]

Q3) A horse has lungs to carryout gas exchange. Horse lungs have almost a 55 litre capacity compared to a human 5 litres.



- a) Describe the pathway of an oxygen molecule from alveolus to the blood? [1 mark]
- b) Explain two feature of the alveolus that allows efficient gas exchange? [2 marks]

During intense exercise a horse's airflow velocity can reach between 3900-4740 litres per minute compared to the human 4 litres per second.

- c) Deduce the maximum value of how many times greater is a horse's air flow velocity compared to a human. Give your answer to 2 significant figures. [1 mark]
- d) Describe the advantage of the Bohr effect during intense exercise? [2 marks]
- e) Describe the structure of the respiratory system in mammals including the mechanism for breathing in? [3 marks]

EPO is a performance enhancement drug that has been used in horse racing to increase the number of red blood cells in the blood. Human athletes have also been known to use this drug, as a result led to an unfair advantage in competitive sports.

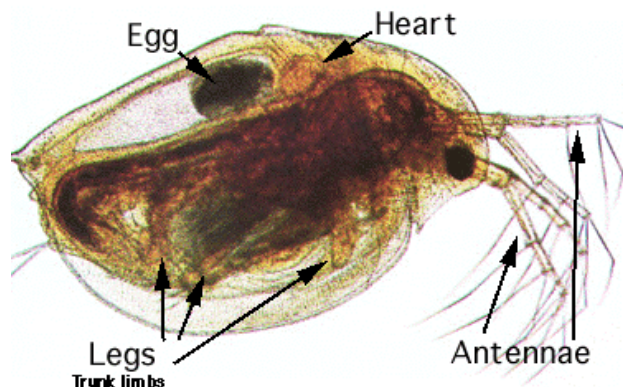
- f) Explain why EPO leads to an unfair advantage? [2 marks]
- g) Athletes who overuse EPO are at greater risk of a heart attack, suggest why? [2 marks]

[Total 13 marks]

*End of Extended Theory 45 marks*

## Practical Theory:

1. A nearby freshwater stream near school contains small water fleas known as Daphnia, they are small invertebrates. A group of students collected a small sample of Daphnia to test the effect of caffeine on their heart rate.



- a) Complete the table for the variables of this investigation: [2 marks]

Independent variable	
Dependent variable	
Control variables	

- b) State the safety precaution needed for this experiment? [1 mark]
- c) Students were provided with a stock solution of 50% Caffeine concentration. Describe the method used to make 10cm<sup>3</sup> of 0.1% solution, 0.25%, 0.5% 0.75% and 1% caffeine solutions. [2 marks]

The students result for 0.1% caffeine solution are shown below:

	Number of heartbeats in 15 seconds				
Length of time in solution (mins)	2	4	6	8	10
Trial 1	54	53	55	53	56
Trial 2	59	58	54	56	57
Trial 3	53	52	54	52	51
Trial 4	56	58	57	56	58
Trial 5	58	60	61	59	60
Mean	56	56	56	55	56
Control 1	53	54	55	54	53
Control 2	58	57	55	56	56
Control 3	57	58	60	59	58
Mean	56	56	57	56	56

- d) What conclusion can be drawn from the students results at 0.1%? [1 mark]
- e) During the investigate the student was counting the number of beats, suggest a suitable improved that could be done to improve the accuracy? [1 mark]
- f) Why were Daphnia left in the solution for a period before being observed? [1 mark]

The group of students mean data from the other concentration are shown below.

	Number of heartbeats in 15 seconds				
Length of time in solution (mins)	2	4	6	8	10
Concentration of Caffeine %					
0.1	56	56	56	55	56
0.25	57	56	57	56	56
0.5	55	56	56	57	55
0.75	63	64	64	65	64
1	66	67	0	0	0

- g) Draw a suitable graph to represent the data shown? [3 marks]
  - h) Describe and explain the effect of caffeine on the heart rate of Daphnia as per the students obtained results? [2 marks]
  - i) Suggest a reason for the results of 1% concentration? [1 mark]
- [Total 14 marks]



2 A meadow has a variety of different plant species growing on it, ecologists wanted to determine the biodiversity of the meadow.



Species	Number of individuals in meadow
Festuco-Brometea	10
CirsioBrachypodion pinnati	5
Brachypodietalia pinnati	14
Bromion erecti	25
Medicago falcata	16

a) Calculate the index of biodiversity using. [2 marks]

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

bi) What is meant by the term species richness? [1 mark]

Bii) Suggest a suitable method that was used to collect data sample used? [3 marks]

[Total 7 marks]

3) A group of students are studying the evolution of a population of birds on a remote island. The island has two distinct types of vegetation: forest and grassland. The birds feed on insects found in both habitats, forests tend to have harder shelled insects than grasslands. You want to investigate whether the different habitats have had an impact on the beak size and shape of the birds.

Describe an experiment that you could carry out to test the hypothesis that the beak size and shape of the birds has evolved differently in response to the different food sources available in the two habitats. Your answer should include:

- a) Write clear hypothesis about the evolution between of beak size and shape between the two different habitats? [1 mark]
- b) Describe the type of data you will need, the sample size and method of data analysis? [3 marks]
- c) Explain the results of the experiment could provide evidence for or against the hypothesis? [1 mark]

One way to study the evolutionary relationships between different species is by comparing their DNA sequences. Two different species of bird analyzed from the grassland area, a sample of blood was taken, and DNA was isolated and compared.

- d) Predict and explain the expected results of this investigation? [1 mark]
- e) Such observations are like the theory of natural selection which was suggested by Charles Darwin. Explain how natural selection had occurred to give rise to these two different species? [3 marks]

[Total 9 marks]

*End of Practical theory 30 marks*