

Candidate Name

Candidate Number

Centre Name

Centre Number


**Paper 1: Biology**

For Examination June 2023

(2 hours)

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 [ ]

**OBJECTIVE SECTION (MCQ):****[Total 25 marks]**

1) Which of the following is not a role of Na<sup>+</sup> ions in organisms?

- A: Transmission of nerve impulses
- B: Acid – base regulation
- C: Opening and closing of stomata
- D: Maintaining cell turgor

2) Which of the following is not made of monomers?

- A: Lipids
- B: Starch
- C: Proteins
- D: Glycogen

3) Which of the following statements are correct when referencing the structure of cellulose?

- 1. *Contains 1-4 glycosidic bonds*
- 2. *Contains 1-6 glycosidic bonds*
- 3. *Contains H bonds*
- 4. *Forms myofibrils*

A: 1, 2, 3 and 4

B: 1, 3 and 4

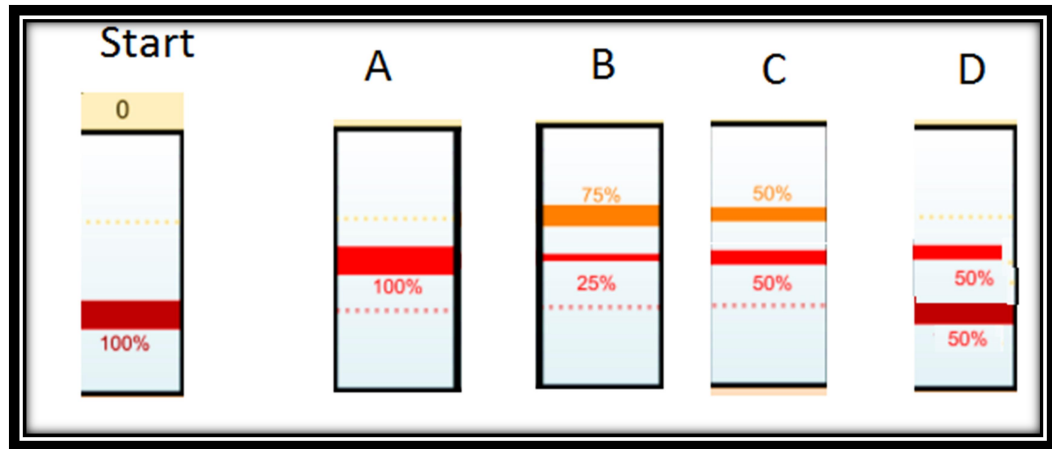
C: 1, 2 and 4

D: 1 and 3 only

4) Collagen is a .....1..... protein that is .....2....., it is made of .....3..... formed by .....4..... reactions involving peptides.

	1	2	3	4
A	Fibrous	Insoluble	Alpha chains	Condensation
B	Globular	Soluble	Beta sheets	Hydrolysis
C	Globular	Insoluble	Alpha chains	Condensation
D	Fibrous	Soluble	Beta sheets	Hydrolysis

- 5) Which image represents the observed evidence for semi-conservative replication by Meselson and Stahl, after the second replication?



- 6) Which of the following statements are true regarding ultrastructure of cell and organelles?

1. Chloroplasts contain 70S ribosomes
2. Mitochondria contain DNA
3. Prokaryote cells contain 80S ribosomes
4. Ribosomes are made of RNA

A: 1, 2, 3 and 4

B: 1, 2 and 4

C: 1, 3 and 4

D: 1, 2 and 3

- 7) Which phase of the cell cycle involves the spindle fibres attaching to the centromere of chromosomes?

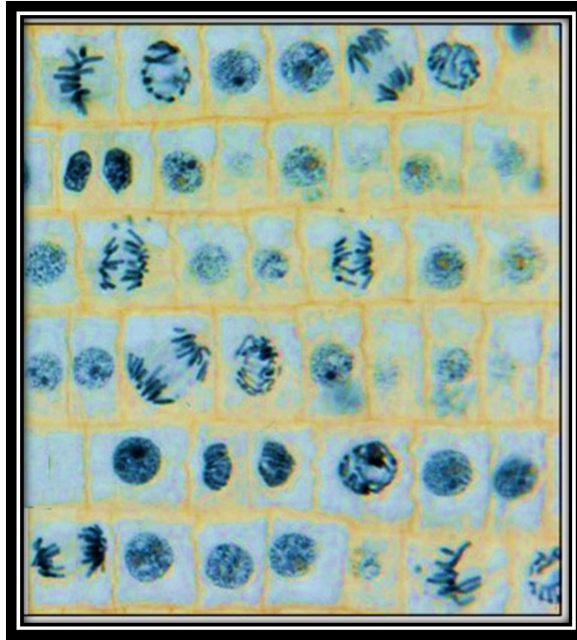
A: Interphase

B: Prophase

C: Metaphase

D: Anaphase

- 8) Calculate the mitotic index of the following root tip squash micrograph with 42 visible cells.



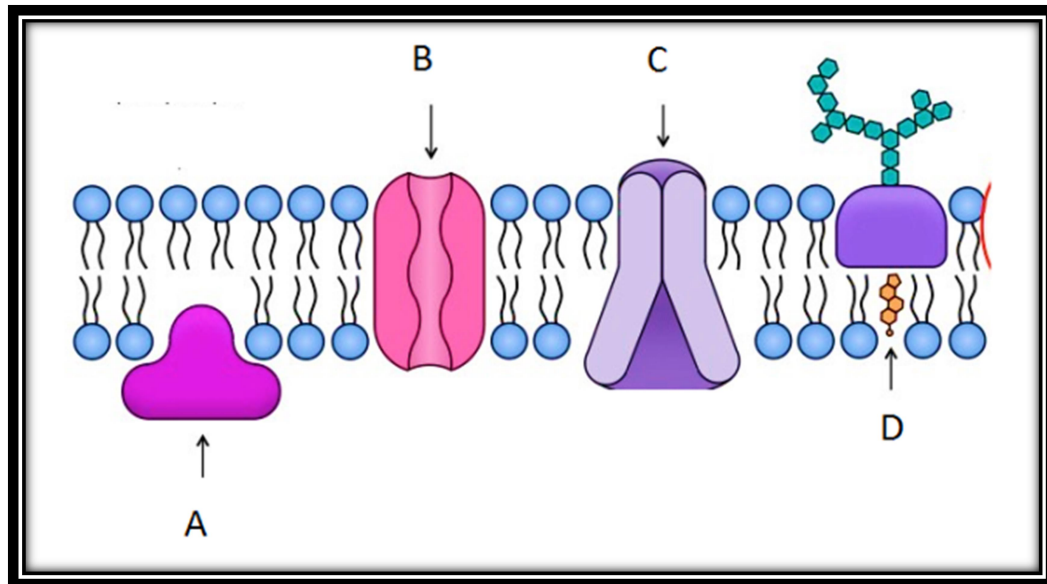
- A: 0.26  
B: 26  
C: 11  
D: 3.81

- 9) Which process involving the movement of substances across the cell membrane use channel proteins?

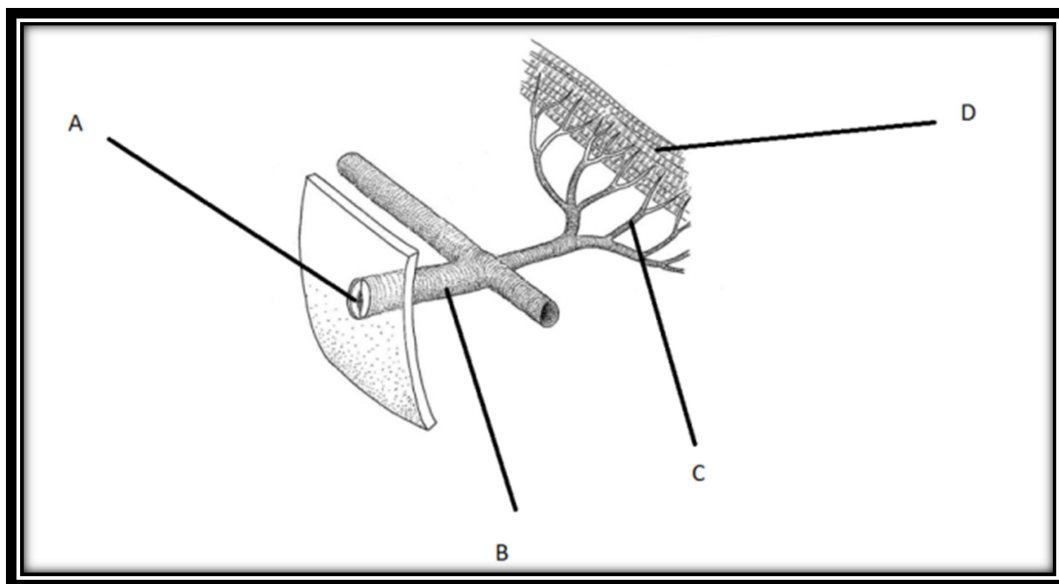
1. *Diffusion*
2. *Osmosis*
3. *Facilitated diffusion*
4. *Active transport*

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

10) Which structure on the cell membrane is responsible for maintaining the fluidity of the cell membrane?



11) Which row correctly labels the tracheal system of an insect?

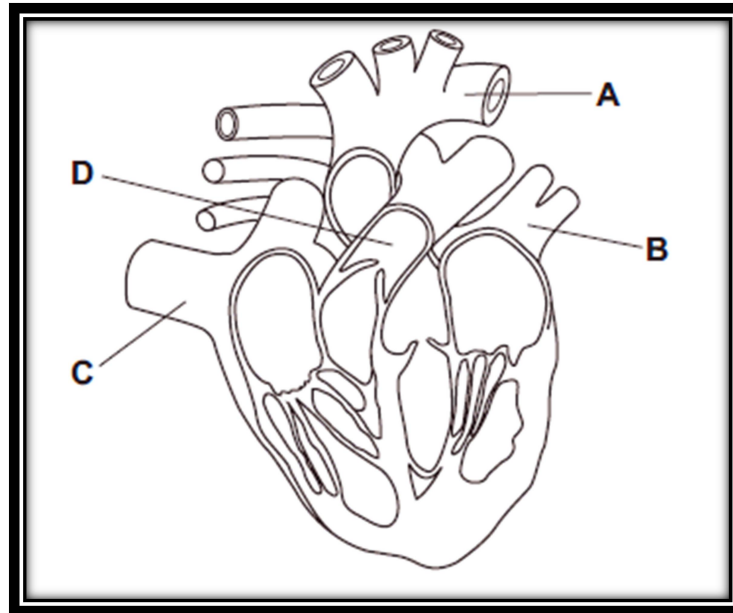


	1	2	3	4
A	Spiracles	Tracheoles	Tracheae	Muscle fibre
B	Tracheoles	Tracheae	Spiracles	Muscle fibre
C	Tracheae	Spiracles	Tracheoles	Muscle fibre
D	Spiracles	Tracheae	Tracheoles	Muscle fibre

**12)** Which row correctly describes the process of exhalation of mammalian lungs?

	Diaphragm	Internal intercostal muscles	External intercostal muscles	Rib movement	Pressure in thorax
A	Contract	Contract	Relax	Down and in	Increases
B	Relax	Contract	Relax	Down and in	Increases
C	Contract	Relax	Contract	Up and out	Decreases
D	Relax	Contract	Relax	Up and out	Increases

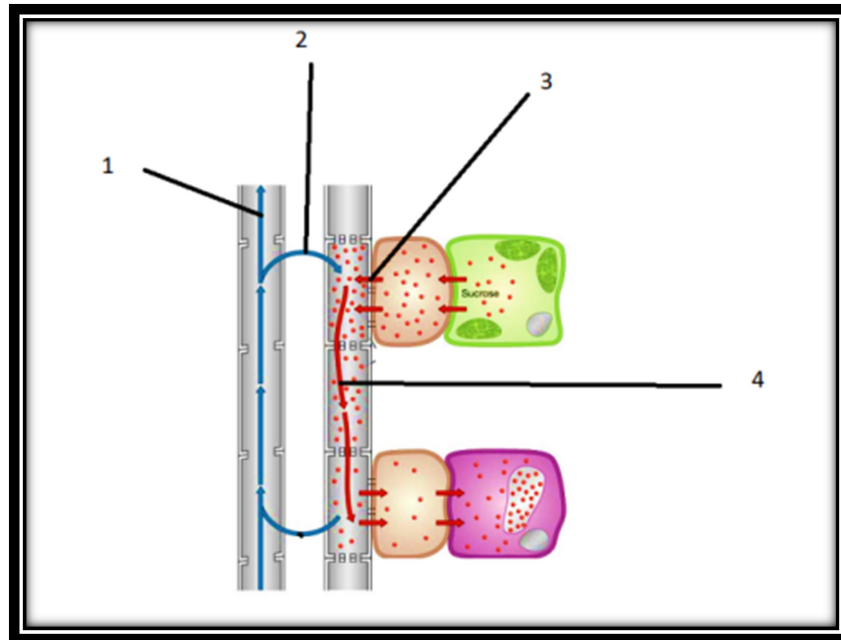
**13)** Which vessel contains the highest concentration of carbon dioxide?



**14)** The cycle of opening and closing of stomata is depends on environmental conditions, which of the following best describes a stomata at 2:00am?

	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	Low
D	Open	Turgid	High	High

15) The most acceptable model for phloem movement is mass flow hypothesis.



	1	2	3	4
A	Water moving due to transpiration stream in the xylem.	Water moving by osmosis due to higher water potential in xylem than phloem.	Solutes actively loaded into phloem by companion cell.	Hydrostatic pressure increases and water moves down phloem.
B	Water moving due to osmosis up the xylem.	Water moving by facilitated diffusion due to higher water potential in xylem than phloem.	Solutes passively loaded into phloem by companion cell.	Hydrostatic pressure increases and water moves down phloem.
C	Water moving due to transpiration stream in the xylem.	Water moving by active transport due to higher water potential in xylem than phloem.	Solutes loaded into phloem by facilitated diffusion companion cell.	Hydrostatic pressure increases and water moves down phloem.
D	Water moving due to translocation stream in the xylem.	Water moving by osmosis due to higher water potential in xylem than phloem.	Solutes actively loaded into phloem by companion cell.	Hydrostatic pressure increases and water moves down phloem.

- 16) A group of students have a solution containing maltose, lactose and sucrose and added two different unknown enzymes were added to the solution. After chemical analysis the two reducing sugars were identified glucose and galactose.

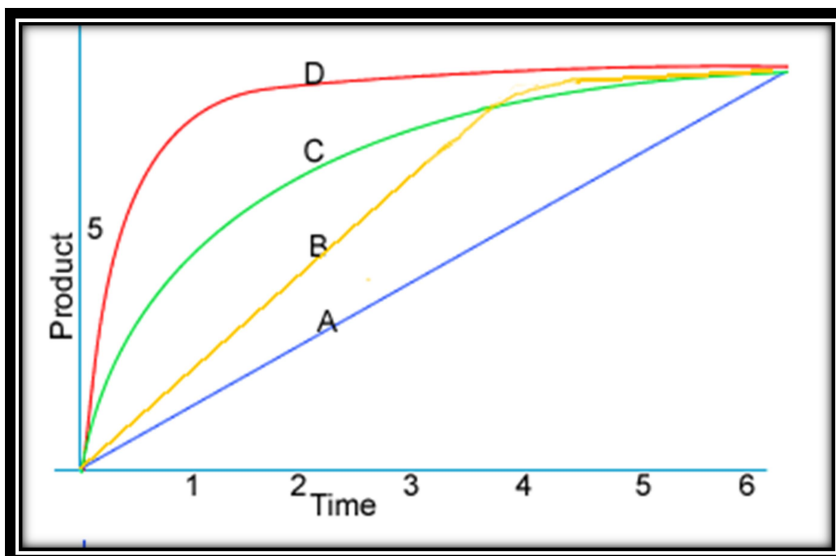
Deduce the two unknown enzymes that were added.

- A: Amylase and Lactase  
 B: Maltase and Lactase  
 C: Amylase and Sucrase  
 D: Maltase and Sucrase

- 17) Which row correctly describes absorption of nutrients in the intestinal villi?

	Fructose	Glucose	Amino acids	Short fatty acid chains	Fat soluble vitamins
A	Active transport	Active transport	Simple Diffusion	Active transport	Simple Diffusion
B	Active transport	Simple Diffusion	Facilitated diffusion	Simple Diffusion	Active transport
C	Facilitated diffusion	Active transport	Active transport	Simple Diffusion	Simple Diffusion
D	Facilitated diffusion	Simple Diffusion	Facilitated diffusion	Active transport	Active transport

- 18) Enzymes are essential for metabolic reactions to occur, which letter represents a non-competitive inhibitor in product formation over time.





19) Which is the correct sequence of events that involve the action by phagocytes?

1. Fusion with lysosome
2. Digestion
3. Microbe detected by phagocyte opsonins receptors and attaches to it.
4. Discharge
5. Microbe is taken in by endocytosis
6. Formation of phagosome

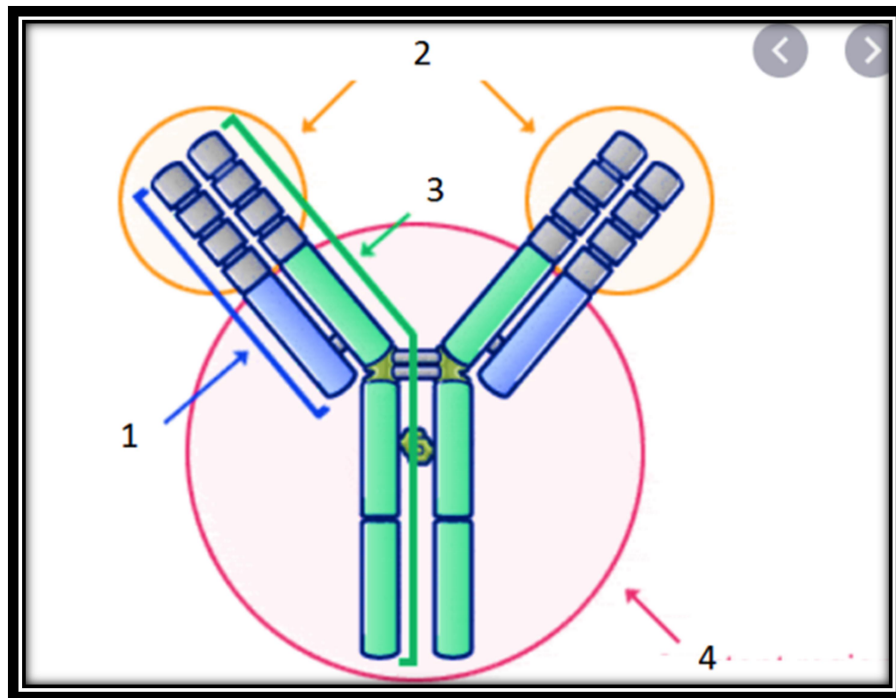
A: 3 > 5 > 6 > 1 > 2 > 4

B: 3 > 6 > 5 > 2 > 1 > 4

C: 3 > 1 > 6 > 5 > 2 > 4

D: 3 > 5 > 1 > 2 > 3 > 4

20) Correctly match the numbers with the general structure of an antibody



	1	2	3	4
A	Variable region	Light chain	Heavy chain	Constant region
B	Light chain	Variable region	Heavy chain	Constant region
C	Heavy chain	Light chain	Constant region	Heavy chain
D	Constant region	Variable region	Light chain	Heavy chain

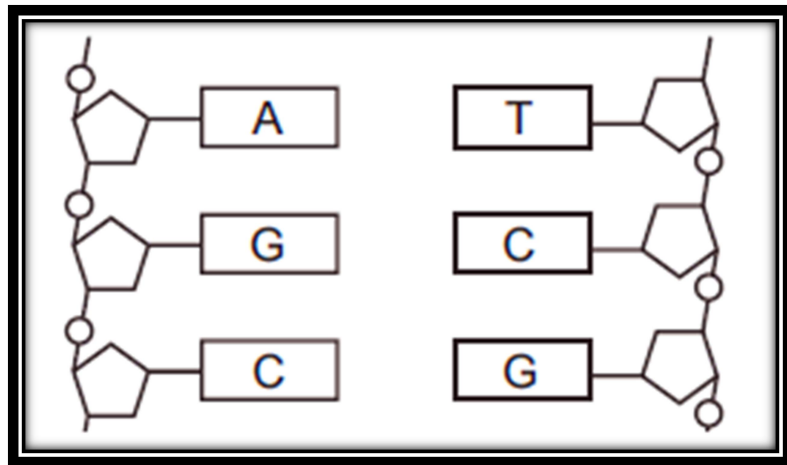
**21)** Acquired immunity is a resistance to a specific pathogen over the life time of an organism.

Which numbers correspond with the appropriate examples?

1. *Natural*
2. *Artificial*
3. *Passive*
4. *Active*

	Vaccination	Breastfeeding	Infections	Injection of anti-venom
A	1 and 3	2 and 3	1 and 4	1 and 4
B	2 and 4	1 and 3	2 and 4	1 and 3
C	1 and 3	2 and 3	2 and 4	1 and 4
D	2 and 4	1 and 3	1 and 4	2 and 3

**22)** How many hydrogen bonds are present in the triplet codon below:



- A: 6  
 B: 9  
 C: 8  
 D: 7

**23)** A single strand of DNA has the following sequence of bases:

TAC GTA CGA ATC

Deduce the tRNA bases that will be complimentary to this sequence.

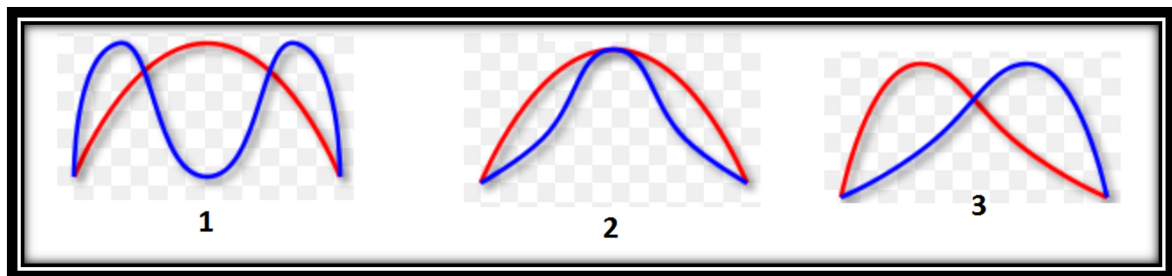
A: AUG CAU GCU UAG

B: TAC GTA CGA ATC

C: ATG CAT GCT TAG

D: UAC GUA CGA AUC

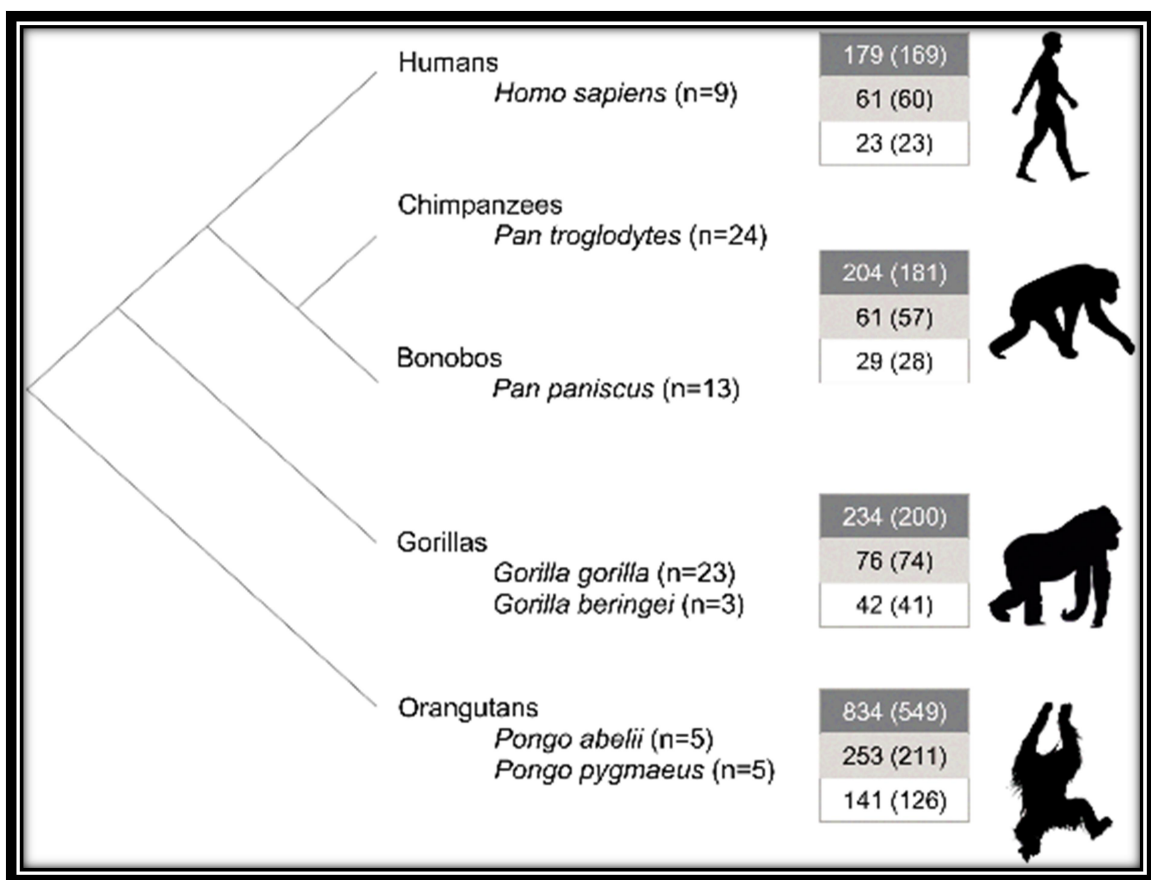
**24)** The Peregrine falcon typically lays around 3 eggs and has 3 offspring, larger numbers may result in offspring dying from malnourishment or if less then not enough viable offspring will survive.



Which is the correct type of selection occurring and corresponding graph?

	Type of Selection	Graph
A	Stabilising	2
B	Disruptive	1
C	Directional	2
D	Directional	3

25) Below is the evolutionary tree of some primates.



Which of the following statements are true?

1. Orangutans and Gorilla are more closely related than Chimpanzee and Humans.
2. Chimpanzees and humans are more closely related than Chimpanzees and Bonobos.
3. Humans and Chimpanzees share the most recent common ancestor.
4. Orangutans are the common ancestor shared by all species.

A: 1, 2, 3 and 4

B: 2 and 3

C: 2, 3 and 4

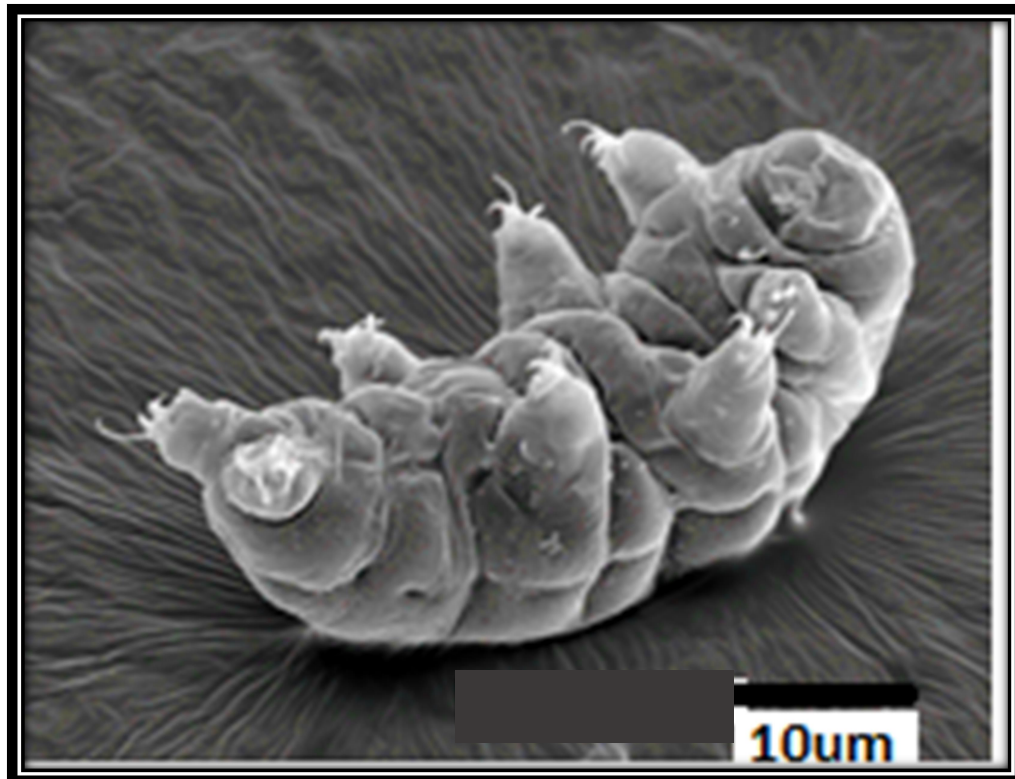
D: 1 only

**EXTENDED THEORY:**

**[Total 45 marks]**

**Q1)**

*Milnesium tardigradum* was discovered in Antarctica by the French zoologist Louis Doyere during an expedition. Tardigrades are animals which are known to be extremophiles but can be found in various other environments such as the desert, sand dunes, mountain tops they have even been known to survive on the moon.



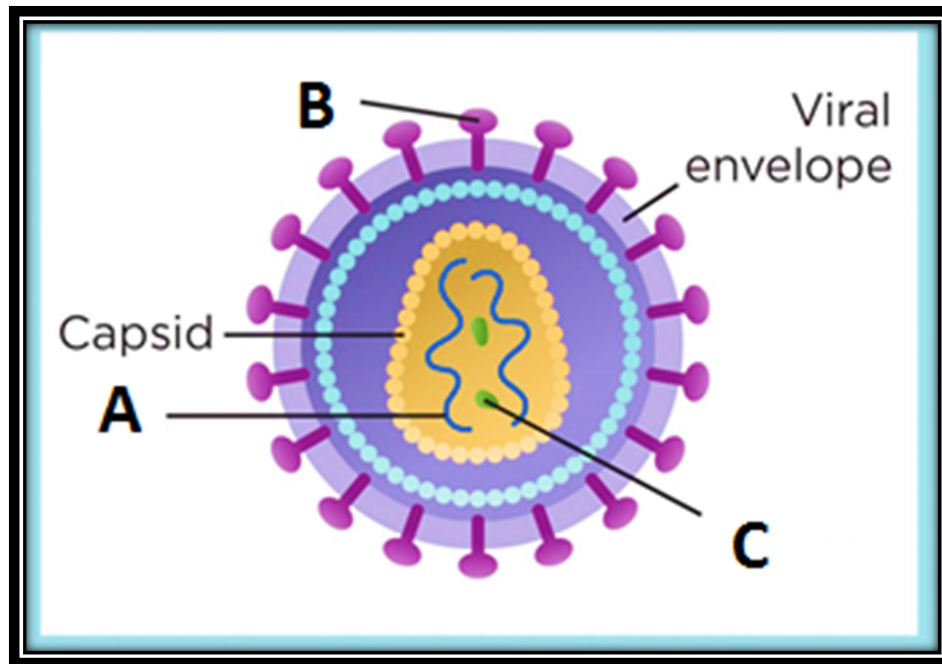
(2.5cm = 10um)

- a) Which Phylum do tardigrades belong to? [1 mark]
- b) Tardigrades can measure up to 1.2mm in length, using Fig 1 calculate the actual length in mm of this tardigrade? Give your answer to 3sf [3 marks]
- c) Deduce the type of microscope used and the necessary steps taken for specimen preparation to observe this image. [4 marks]

**[Total 8 marks]**

**Q2)**

Human immunodeficiency virus is an enveloped virus, which can lead to the condition known as AIDS.



a) Name structures [2 marks]

A.....

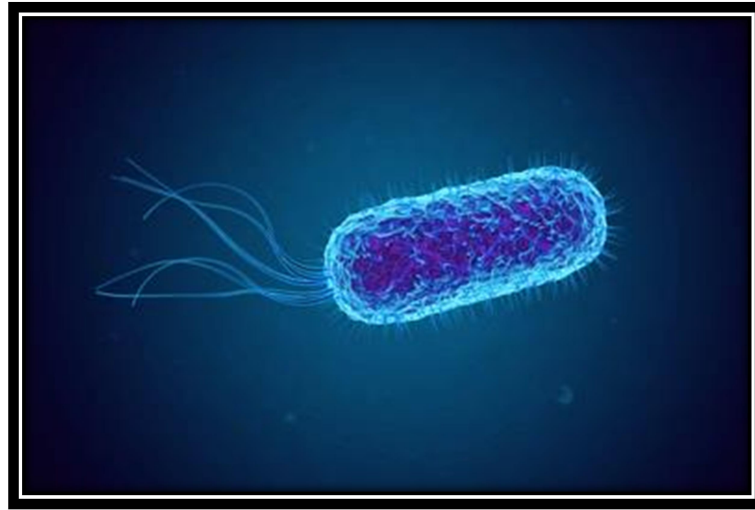
B.....

C.....

b) Describe how HIV infects a T helper cell? [6 marks]

c) Define the term shedding and state method used by HIV virus? [2 mark]

Another pathogen is *E. coli* which is a bacterium.



d) Name 2 structures which are found in bacteria but not in viruses. [1 mark]

e) Describe the process by which bacteria reproduce. [3 marks]

[Total 14 marks]

### Q3)

The human gas exchange system includes all structures associated with exchanging gases with the environment.

a) Complete the table to indicate tissues found in those structures with either tick (✓) or cross (X)

	Cartilage	Ciliated epithelium	Goblet cells	Smooth muscle	Connective tissue
Trachea					
Bronchi					
Bronchioles					
Alveoli					

[4 marks]

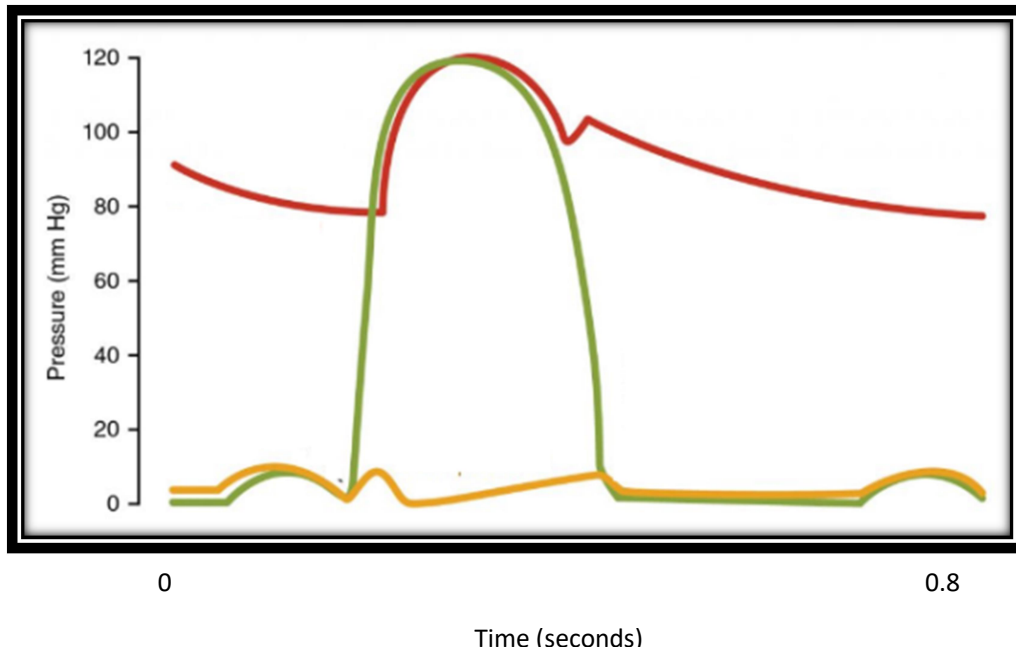
Elastic fibres play an important role in the gas exchange system, but they also have a significant role in the circulatory system.

b) Describe and explain the role of elastic tissue in a named blood vessel? [3 marks]

c) Describe the cardiac cycle? [4 marks]

d) The diagram below represents the pressure changes and valve movements in the left side of the heart. Add labels to represent the semi-lunar values and AVN valves opening and closing?

[2 marks]



The cardiac output is total volume of blood pumped by one ventricle of the heart in one minute.

e.) Calculate the cardiac output if a person has a heart rate of 65 beats a minute and has a stroke volume of  $5.1 \text{ dm}^3$ ?

[2 marks]

[Total marks 15]

#### Q4)

a) Describe the process of translation. [4 marks]

b) Evaluate the impact of deletion and substitution mutations and explain its impact on a translation. [4 marks]

[Total 8 marks]



## PRACTICAL COMPONENT:

[Total 30 marks]

### Q1)

Diabetes is a rising condition among adults around the world, in the US 38 million individuals of all ages had the condition. Glucose is not normally present in the urine of healthy individuals as it is selectively reabsorbed, however, individuals who suffer from diabetes often have higher than normal concentration of glucose present in the urine.

A group of students been provided a sample of urine to analyse.

Equipment list available:

- Urine sample
- Colorimeter
- 0.5M glucose solution
- Test tubes
- Test tube rack
- Water bath at 90 °C
- Pipettes
- Syringes



- a) State the name of the process to create a 0.25M glucose solution from 0.5M solution. [1 mark]
- b) Describe the method how students created solutions of 0.125M, 0.05M, 0.025M and 0.01M glucose solution. [3 marks]

Each solution was tested for reducing sugars using benedict's quantitative solution, and absorbance was measured using a colorimeter, below is the results:

Concentration of glucose (M)	0.5	0.25	0.125	0.05	0.025	0.01
Absorbance Arbitrary units	0.30	0.52	0.65	0.70	0.73	0.78

- c) Draw a calibration curve for the results? [4 marks]
- d) The students repeated the process for the urine sample and identified the absorbance of 0.42. Using your calibration graph deduce the urine sample's concentration? [1 mark]
- e) State two safety precautions the students needed to consider during this experiment. [1 mark]

[Total 10 marks]

## Q2)

- a) Design a suitable experiment to test the effectiveness of antibiotic A and antibiotic B using aseptic techniques E. coli? [6 marks]
- b) How do antibiotics reduce bacteria populations? [1 mark]
- c) Antibiotic resistance is a growing concern in the medical world for the fight against pathogenic diseases. Explain how bacteria may become immune to antibiotics? [3 marks]

[Total 10 marks]

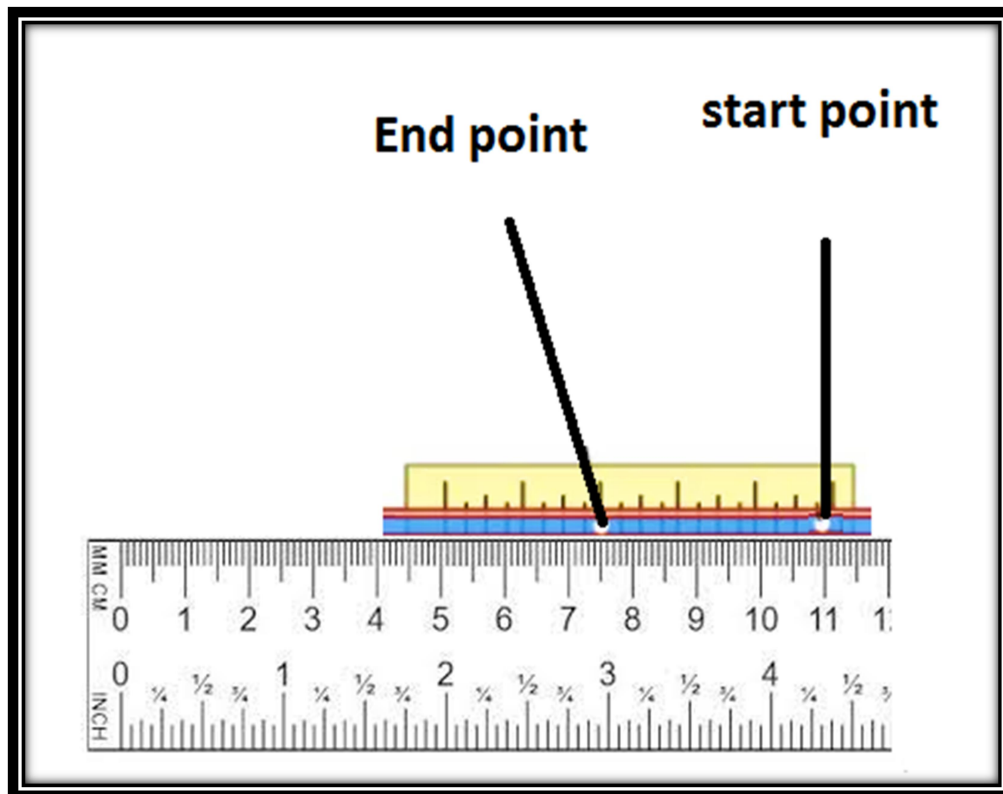
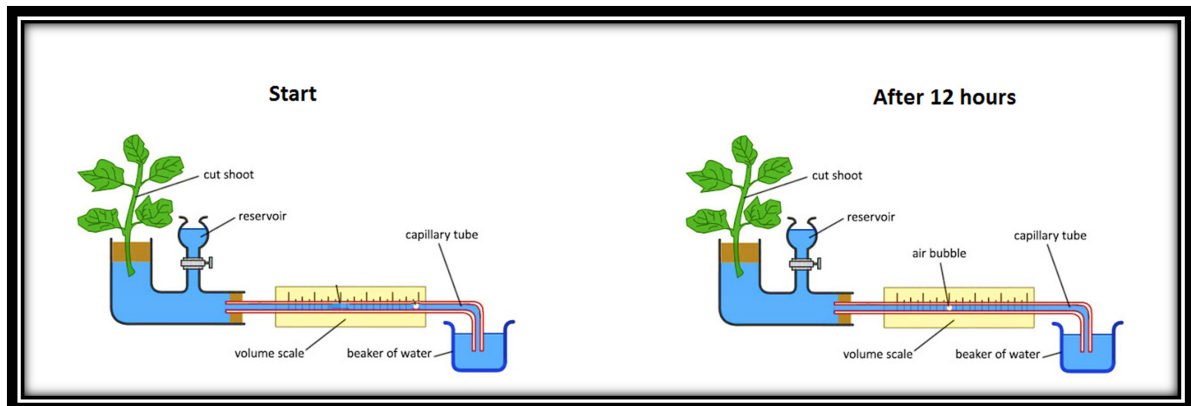
**Q3)**

Measure the rate of transpiration using a potometer. The rate of transpiration is proportional to water uptake. The diameter of the capillary tube used is 1.0 mm.

Students are investigating how temperature affects the rate of transpiration.

- a) Name two control variables that the students would need to consider. [1 mark]

The students carried out the investigation at 25 °C the before and after experiment is shown below?



- b) Using your knowledge, calculate the rate of transpiration per hour. The formula below will assist you in the calculation. [4 marks]

Volume of a cylinder:  $V = \pi r^2 l$

- c) Predict the location of the air bubble at the following temperatures and explain your answer?

- i) 10°C .... [2 marks]
- ii) 40 °C .... [ 2 marks]
- iii)

- d) Explain the purpose of the reservoir and tap for this practical? [1 mark]

[Total 10 marks]