



Candidate Name

Candidate Number

Centre Name

Centre Number

Paper 2: 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]

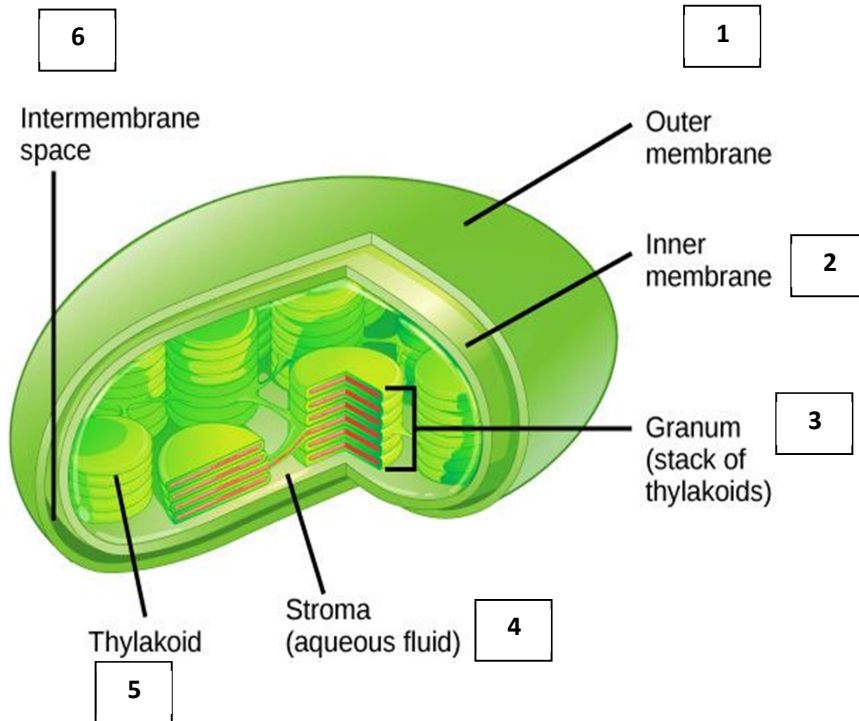
1 – Acetyl Coenzyme A is an important biomolecule in respiratory metabolism of many substrates. In which stage of respiration is Acetyl Coenzyme A produced?

- A – Glycolysis
- B – Link Reaction
- C – Krebs Cycle
- D – Oxidative phosphorylation

2 – Respiration involves the generation of ATP from ADP and inorganic phosphate. What is the total net ATP formed through substrate level phosphorylation throughout the stages of respiration?

- A – 2
- B – 4
- C – 32
- D – 34

3 – Which of the following labelled structures is used to provide evidence for the endosymbiotic theory, stating that chloroplasts were likely once independent bacterial organisms?



- A – 1+2
- B – 3
- C – 4+5
- D – 2+6

4 – Which of the following statements is **not** correct for cyclic photophosphorylation occurring in photosynthesis?

- A – Only PS1 involved
- B – Water is not required
- C – Oxygen is not required
- D – NADPH is synthesized

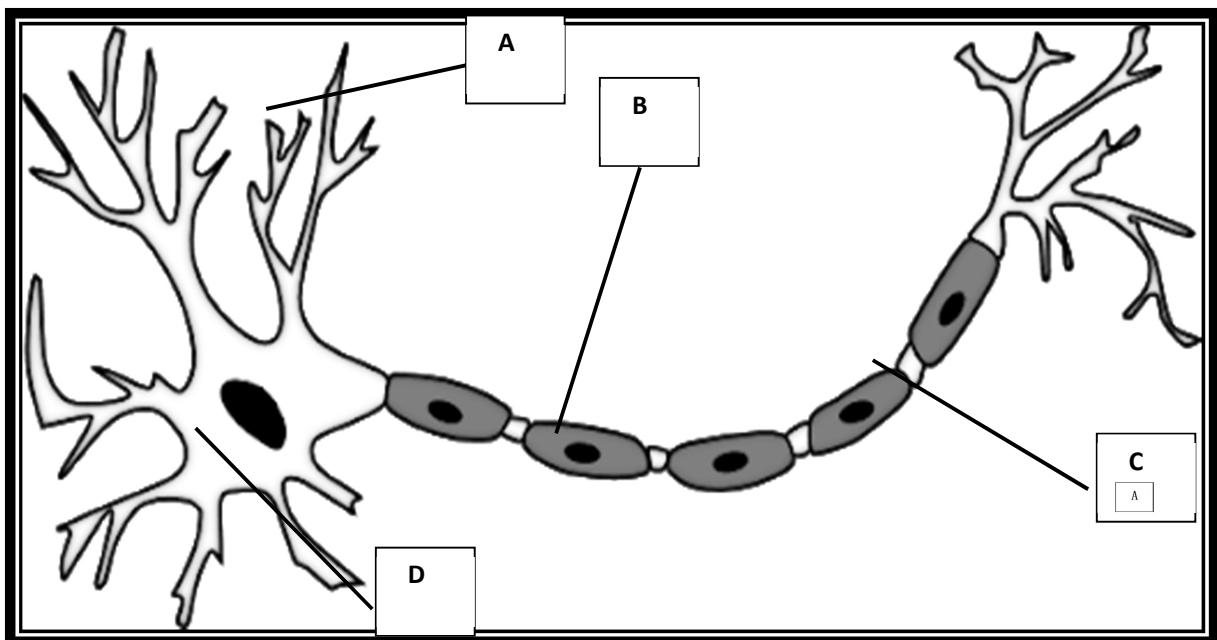
5 – The Calvin cycle is the process allows the carbon dioxide taken from the atmosphere to be converted to carbon and then useful substrates for the plant, most commonly sugars. Which of the following is a chemical not found during this cyclic process?

- A – Ribulose Biphosphate
- B – Glycerate 3 phosphate
- C – Triose Phosphate
- D – Pyruvate

6 – Which of the following statements correctly describes positive phototropism in a plant shoot?

- A – Movement or growth towards light as a stimulus due to a collection of auxins on the non-shaded side of the plant
- B – Movement or growth away from light as a stimulus due to a collection of auxins on the shaded side of the plant
- C – Movement or growth away from gravity as a stimulus due to a collection of auxins on the lower side of the plant
- D – Movement or growth towards light as a stimulus due to a collection of auxins on the shaded side of the plant

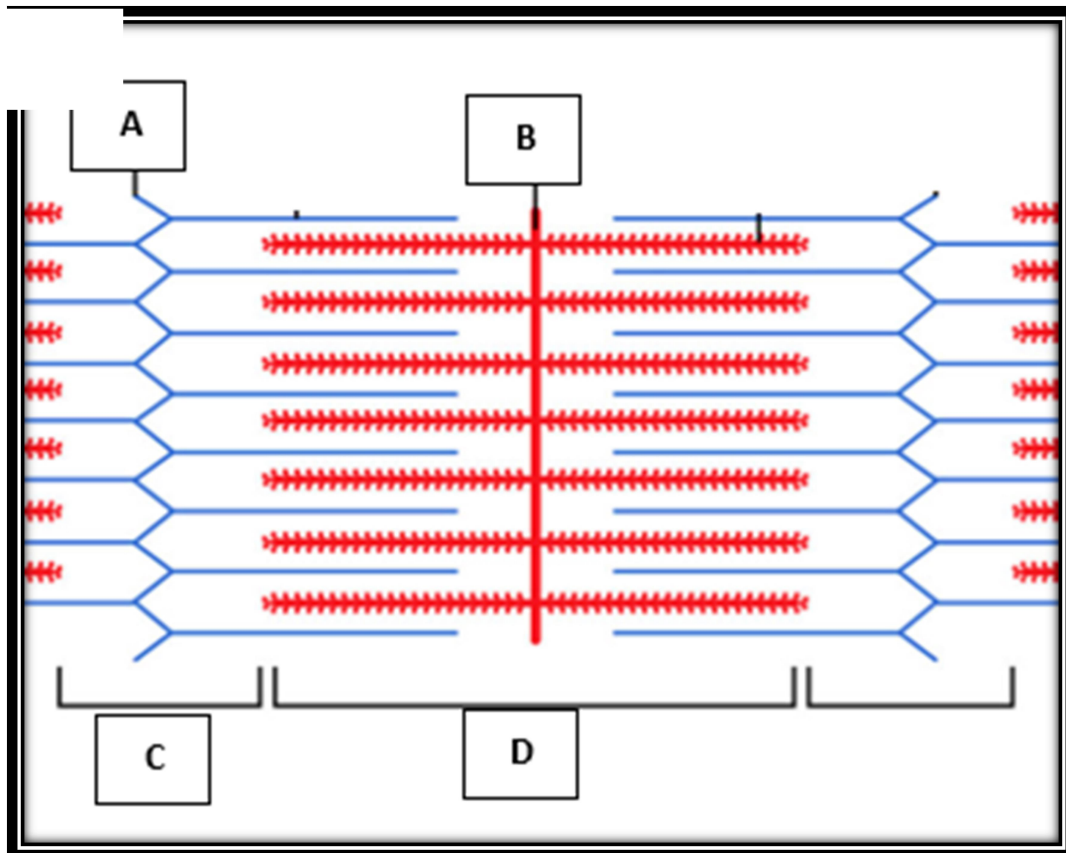
7 – Correctly identify the “Nodes of Ranvier” on the below diagram.



8 – The speed of a travelling action potential along an axon can be influenced by a variety of factors, which of the below is not a factor affecting speed of the action potential?

- A – Temperature
- B – Axon Diameter
- C – Myelination
- D – Axon Length

9 - On the labelled sarcomere diagram below, correctly identify the I band found in all contractable sarcomere units.



10 – Glucoregulation is an important homeostatic function containing a variety of different pathways involving glucose within the human body. One such pathway is “the formation of glucose from non-glucose sources”, which of the following terms defines this pathway.

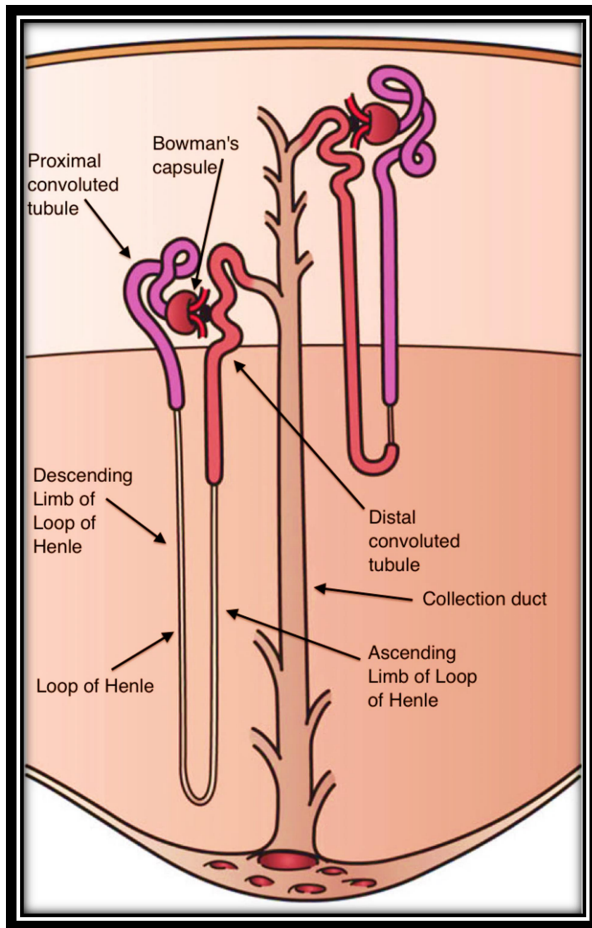
- A – Glycogenolysis
- B – Glycogenesis
- C – Gluconeogenesis
- D – Glycolysis

11 – Select the correct sequence, detailing the correct sequence for an action potential to be formed and transmitted along a neuron.

1	Threshold
2	Falling phase
3	Resting potential
4	Recovery phase
5	Rising phase

- A – 3,1,4,5,2
- B – 3,1,5,2,4
- C – 5,2,4,1,3
- D – 3,2,5,1,4

12 – Correctly identify on the diagram the area of highest salinity in the kidney tissue, which aids with nephron function.



A

B

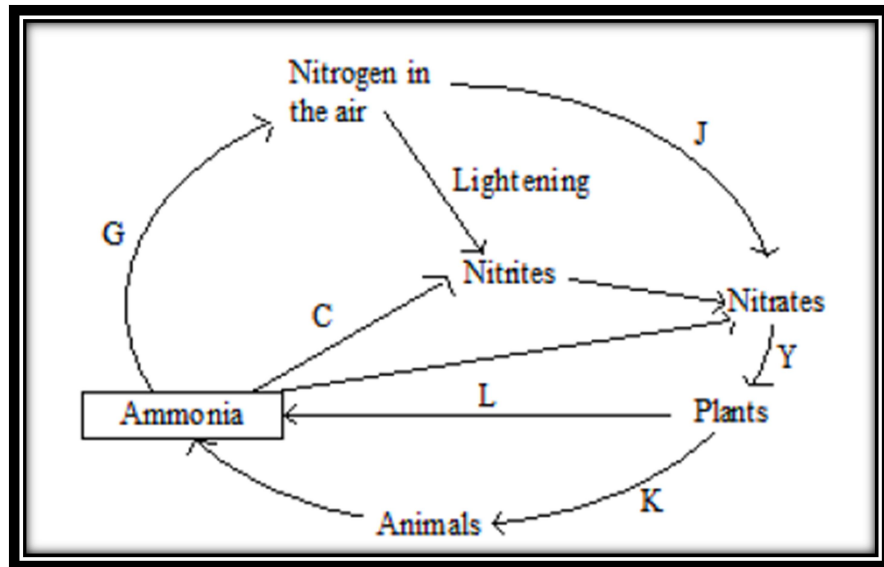
C

D

13 – Which statement correctly identifies the potential for energy to be lost from an ecosystem?

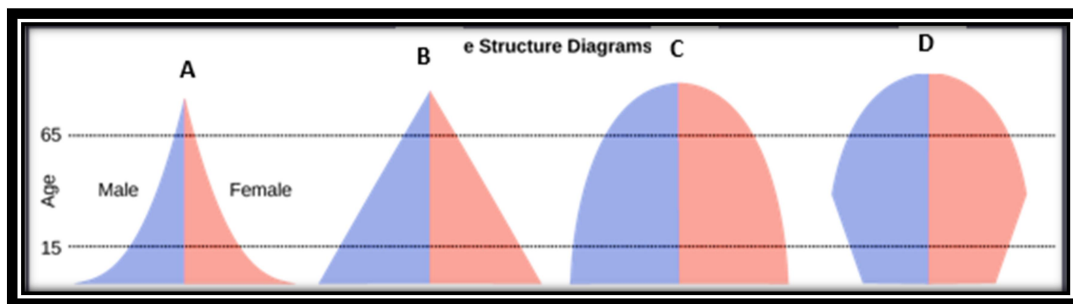
- A – Energy is lost from an ecosystem through inedible parts of an organism not being passed along the food chain.
- B – Energy is lost from an ecosystem though heat transfer to the surroundings.
- C – Energy is lost from an ecosystem through decomposition of dead/decaying organisms.
- D – Energy is lost from an ecosystem through consumption of an organism in the second trophic level by the third trophic level.

14 – Correctly identify the process taking place at J.



- A – Nitrogen fixation
- B – Denitrification
- C – Nitrification
- D – Decay

15 – Which diagram represents a rapidly growing population demographic?



16 – What is the correct definition for sustainable forestry?

- A – Viable replacement of any trees felled with newly germinating trees or seeds.
- B – Management of total trees felled per annum.
- C – Replanting of new forests in uninhabited areas of viable land.
- D – Felling of only dead/sick trees.

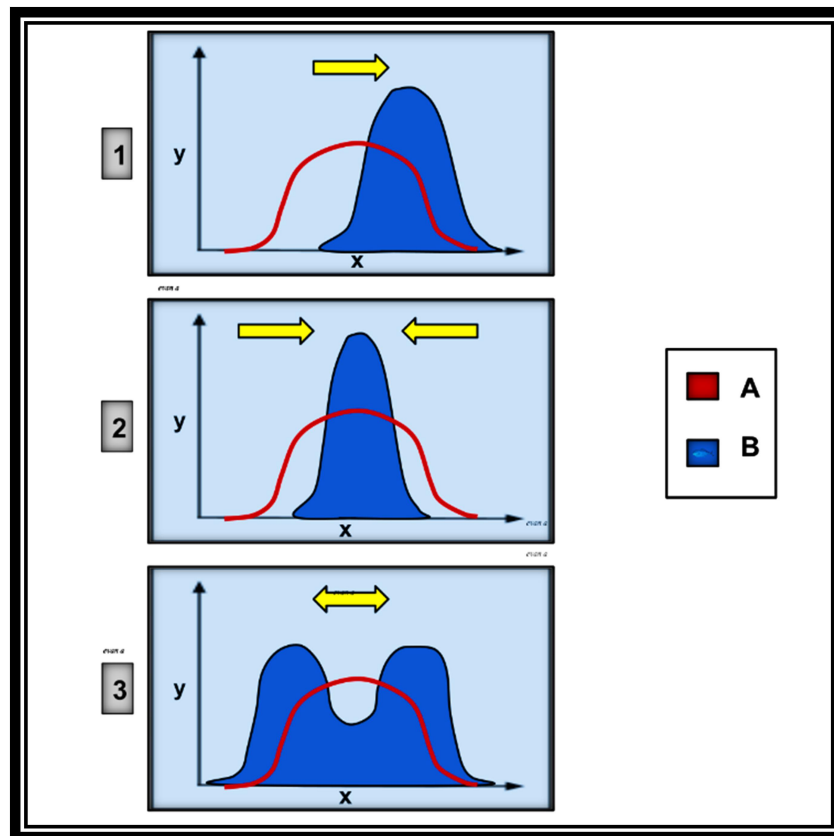
17 – Neurofibromatosis is an autosomal dominant disease gene. A heterozygous father displaying the disease as his phenotype and a mother not displaying the disease have 4 children. How many would you expect to display the disease as their phenotype?

- A – 1
- B – 2
- C – 3
- D – 4

18 – A population of 1000 goats exhibits a homozygous dominant brown-hair colour and a heterozygous brown-hair colour in 890 of the individuals. What is the value of the recessive allele (q) in the Hardy-Weinberg calculation?

- A – 110
- B – 0.23
- C – 0.33
- D – 0.11

19 – Correctly identify the diagram displaying a stabilizing population.



- A – 1
- B – 2
- C – 3
- D – 2+3

20 – The following statement defines which principle in population inheritance?

“Sharp decrease in population size due to a naturally occurring rare event or human influence”

- A – Genetic bottleneck
- B – Genetic Drift
- C – Founder effect
- D – Genetic isolation

21 - What does the following change in the first 12 bases in a DNA sequence following the start codon demonstrate?

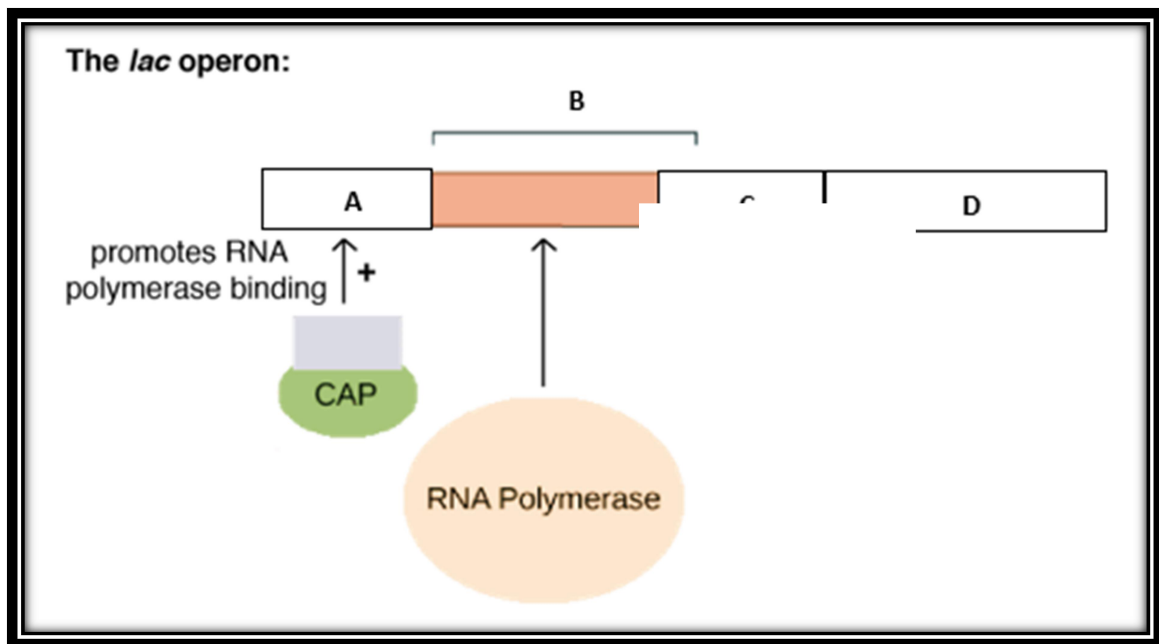
ATTATCATGCCG → **ATTACATGCCGC**

- A – Transcription
- B – Deletion
- C – Addition
- D – Point mutation

22 – Select the correct definition for the function of telomerase.

- A – The conversion of telomeres as a substrate to individual bases as a product.
- B – The breakdown of telomeres in the nucleus of a cell.
- C – The removal of bases from the telomeres of a chromosome.
- D – The addition of bases to the telomeres of a chromosome.

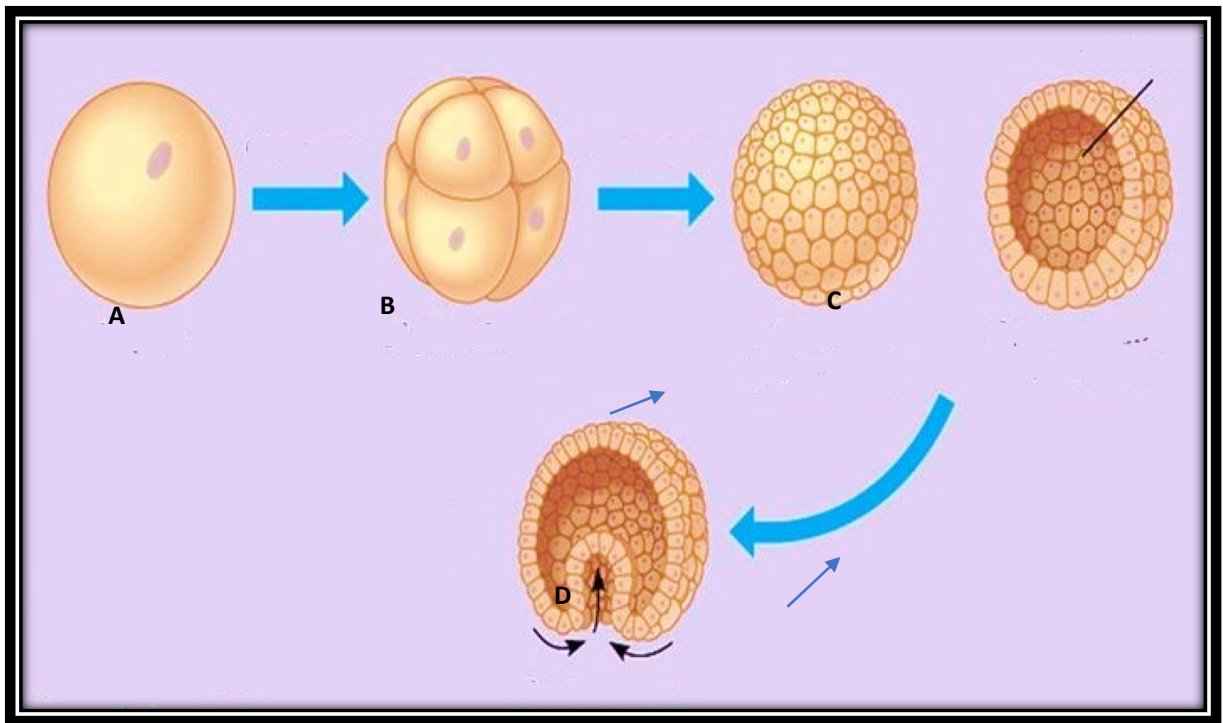
23 – Correctly identify the promotor region of the following diagram detailing the lac operon.



24 – Which of the following statements would be considered a social issue regarding use of DNA cloning technologies in industries.

- A – Cloning an individual could be considered “playing god”.
- B – A cloned individual could be rejected by peers due to their status.
- C – A cloned individual could be created that was more efficient at a given task, replacing non-cloned individuals.
- D – A clone is genetically identical to the original individual.

25 – Identify the blastocyst stage on the following diagram.

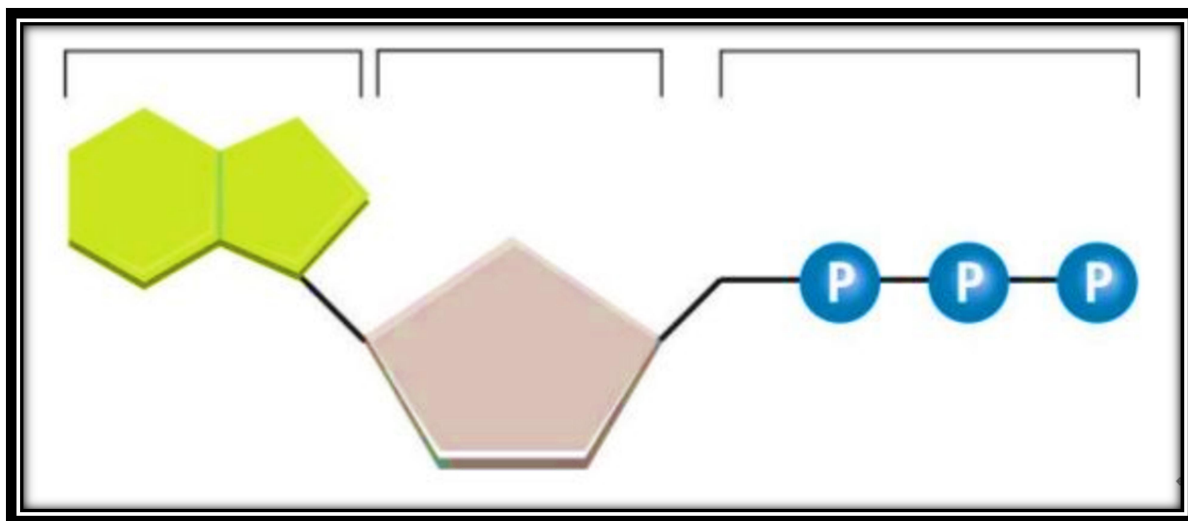


EXTENDED THEORY:

[Total 45 marks]

Q1 – ATP is a vital biomolecule in almost all mammals, including humans.

a) Label the diagram below identifying the three basic building blocks for ATP. [3 marks]



b) i) ATP is synthesized most during aerobic respiration in an organism; however, this process contains more than one pathway for the synthesis of the biomolecule. Compare the difference between two potential pathways for synthesis of ATP, include detail. [4 marks]

Substrate level phosphorylation

Oxidative phosphorylation

ii) ATP is also synthesized during photosynthesis, name the process that provides ATP in the chloroplast of a typical palisade cell. [1 mark]

- c) ATP from photosynthesis is then used during the Calvin cycle to produce substrates, many of which are transported in the phloem. Identify the phloem on the cross section below with an X. [1 mark]



- d) Explain how sucrose is loaded into the phloem. [2 marks]

[Total – 10 marks]

Q2 – Certain species, known as endemic species, can only be found in certain locations. The Fossa is one such species and is endemic to Madagascar, an island including many biomes and habitats.



- a) The Fossa can survive on the island of Madagascar as it has, through adaptation, filled a niche. Give the definition of a niche. [1 mark]
- b) In recent years, Human Impacts on the island of Madagascar have been severe, an estimated 10% of the original forested area now remains. The data below shows the change in time of forest cover and Fossa populations.

	1985	2020
Area of forested area in millions of hectares	134.2	12.5
Number of Fossa present in thousands	34	2.5

- i) State the relationship between forest cover and Fossa population size. [1 mark]
- ii) Calculate the decrease in population of Fossa over the last 45 years. Give your answer as a percentage as a whole number. Show your working. [2 marks]

- c) The loss of Fossa population is predominantly due to loss of habitat. Suggest one other reason that the Fossa population size has decreased. [1 mark]
- d) Some scientists suggest that the decrease in forested area and livable habitats in Madagascar has already impacted certain organisms irreversibly. The reduction in habitats has led to genetic bottleneck of certain species, this has been suggested as a possible impact on Fossa. Explain the term genetic bottleneck and the impacts that it may have on Fossa endemic to Madagascar. [4 marks]
- e) Conservationists wishing to protect endemic species present in Madagascar wish to intervene and set up sustainable forestry practices with the people living on Madagascar as well as companies using the land for agricultural purposes. Describe sustainable forestry and explain the impacts it could have on endemic species such as Fossa. [3 marks]

[Total marks – 12]

Q3 – Many British gardens are home to Geranium plants. Geranium plants show a great deal of variety in colour and petal size. They also exhibit autosomal linkage commonly between many of their genes.

a) Define the term “autosomal linkage” below. [2 marks]

Some common genes found within Geranium species are stated below.

Petal Size Alleles. **P** – Large petals. **p** – small petals

Petal Colour Alleles. **B** – Blue petals. **b** – Green petals.

- b) Below show a typical cross for the F2 generation of the plant Geraniums. Give the phenotypic outcomes as a ratio. [4 marks]
- c) Explain why the ratio produced from this common F2 cross is not synonymous with genes linked through autosomal linkage. [2 marks]
- d) Commonly plants are easily bred together to gain desired traits, a form of selective breeding. One such gardener in the UK uses the Hardy Weinberg principal to estimate the outcomes of her bred plants. On average she would receive 75 red plants in total, in every 100. Use the Hardy Weinberg principal to estimate the total of these 75 plants that are heterozygous dominant recessive. Show your working. [3 marks]

[Total marks – 11]

Q4 – Meiosis and Mitosis are both essential cellular divisions for the continuation and propagation of new life.

Meiosis produces gametes that contain half the chromosomes needed for a new organism, a haploid cell. Most animals use meiosis for reproduction; however, some animals use mitosis.

a) Give an example of an animal that can reproduce using mitosis and explain the differences between this form of reproduction and gamete-based reproduction. (3 marks)

Example:.....

Differences

Often organisms that have reproduced using mitosis are heavily reliant on stem cells for the formation of a new organism.

b) i) What is a stem cell, and explain its importance in new organisms [2 marks]

- ii) The stem cells initially formed in meiotically dividing organisms are known as pluripotent stem cells. It is currently illegal to harvest these stem cells in most circumstances from humans. Discuss the ethical implications of pluripotent stem cell harvest in humans. [4 marks]
- iii) New medical technologies have meant it is possible to induce pluripotency in stem cells. Explain the principle behind inducing pluripotency. [3 marks]

[Total marks – 12]

PRACTICAL COMPONENT:

[Total 30 marks]

- 1) Drug production in modern society is an important contributing factor to the outcomes and success of hospitals and the health care systems in place.

Many drugs were originally derived from plants, and often new drug trials begin with the testing of many plant compounds. These plants must be produced on a large scale and without much, if any, genetic differences, so that tests remain fair.

One such way to produce genetically identical plants is to micropropagate.

- a) Describe and explain how a drug production company would micropropagate a small herbaceous plant for large scale drug extraction. [5 marks]
- b) One drug company regularly tests the plant biomass produced from micropropagate plants and those grown naturally, through germination of seeds. Design a suitable experiment for testing the difference in organic biomass of plants produced by both regular germination and micropropagation. [7 marks]
- c) Give one reason why this experiment may not be considered fair. [1 mark]
- d) Suggest why the scientists would wish to consider the **NPP** and how you would work out the NPP of plants grown through either method, ready for extraction of chemicals for drug production. [2 marks]

[Total marks – 15]

- 2) Scientists are investigating the distribution of a variety of seagrasses along the sea floor of an area that recently been the site of environmental investigation, due to potential pollution of the surrounding area by a factory.

The data below shows the distribution of seagrasses along the seafloor, ranging from the shoreline – 0 metres, to 500 metres at sea, investigated using an belt transect.

Distance	Seagrass Species 1	Seagrass Species 2	Seagrass Species 3
0-100m	54	32	67
101-200m	34	13	35
201-300m	57	67	98
301-400m	56	76	102
401-500m	68	89	108

- a) Plot the above data on a kite in the graph space provided below. (5 marks)

- b) One scientist suggested that the data between 101-200 meters supports the theory that the factory is producing chemicals which are impacting on the growth of seagrasses.
- i) Suggest alternative reasons for the lack of seagrass found between 101-200 metres. [2 marks]
- ii) Explain what further data would be required to make a statement about the impact of the factory and its potential pollution of the water surrounding. [2 marks]
- iii) Evaluate the benefits and drawbacks of using an uninterrupted belt transect over a line transect when looking at distribution of species over 500 metres. [3 marks]
- c) A further evaluation of the site surrounding the factory aims to investigate the impact on biodiversity of plant life in the immediate 100m² area surrounding the factory.

Using the Simpson's index, stated below, to calculate the biodiversity index of the area, give your answer to 3 d.p. Show your working (3 marks)

Species	Total Population
Seagrass species 1	2,605
Seagrass species 2	5401
Seagrass species 3	3020
Seaweed species 1	343
Seaweed species 2	239

$$D = 1 - \left(\sum \left(\frac{n}{N} \right)^2 \right)$$

[Total marks – 15]