SECTION A (40 MARKS)

*Answer **ALL** questions*

Question 1 **[15]**

a) For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. DO NOT circle more than ONE alternatives. If there are more than ONE circled alternatives, NO score shall be awarded.

i. The cell organelle responsible for formation of lysosome and vacuole is

A endoplasmic reticulum.

B golgi body.

C ribosome.

D nucleus.

ii. Which of the following tissues initiate the formation of lateral roots and vascular cambium during secondary growth in plants?

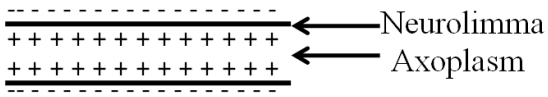
A vascular bundles

B endodermis

C pericycle

D cortex

iii. The given figure shows a part of a nerve fibre conducting impulse.



Which of the following state is represented in the figure?

A depolarised state

B repolarised state

C polarised state

D resting state

iv. Which of the following is true about the function of the endoplasmic reticulum?

A transportation of protein

B breakdown of protein

C synthesis of protein

D storage of protein

v. During intense exercise, a person experiences muscle fatigue due to the accumulation of lactic acid. The correct metabolic pathway to breakdown the lactic acid is

A lactic acid ⟶ liver ⟶ muscle ⟶ glucose

B lactic acid ⟶ muscle ⟶ glucose ⟶ liver

C lactic acid ⟶ liver ⟶ glucose ⟶ muscle

D lactic acid ⟶ glucose ⟶ liver ⟶ muscle

vi. Sangay and Dorji are born to the same parents. However, Sangay resembles his mother while Dorji resembles both the parents. This is due to a special phenomenon that occurs during meiosis called

A terminalisation.

B crossing over.

C disjunction.

D synapsis.

vii. Which of the following cells secret HCl in the stomach?

A argentaffin cell

B goblet cell

C paneth cell

D oxyntic cell

viii. The enzymes involved in DNA replication are correctly matched with their functions **EXCEPT**

A DNA polymerase-I ----proofreading.

B Helicase --------- wind DNA strands.

C Primase ---- synthesis RNA primer.

D Ligase ----joins DNA strands.

ix. The net ATP produced in one complete Krebs cycle is

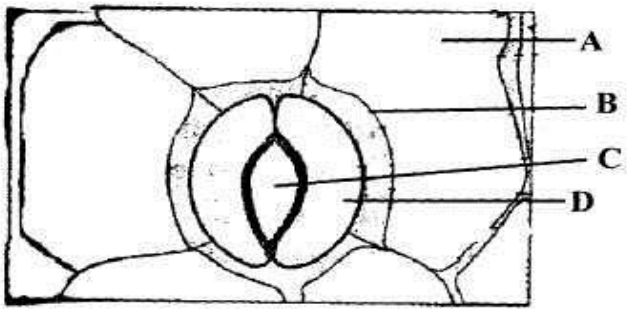
A 24 ATP.

B 12 ATP.

C 8 ATP.

D 6 ATP.

x. Study the diagram of a stomatal apparatus given below.



Choose the serial number in which A, B, C and D are labelled correctly.

Sl. No.	A	B	C	D
1	Subsidiary cell	Epidermal cell	Guard cell	Stoma
2	Guard cell	Stoma	Subsidiary cell	Epidermal cell
3	Epidermal cell	Guard cell	Stoma	Subsidiary cell
4	Epidermal cell	Subsidiary cell	Stoma	Guard cell

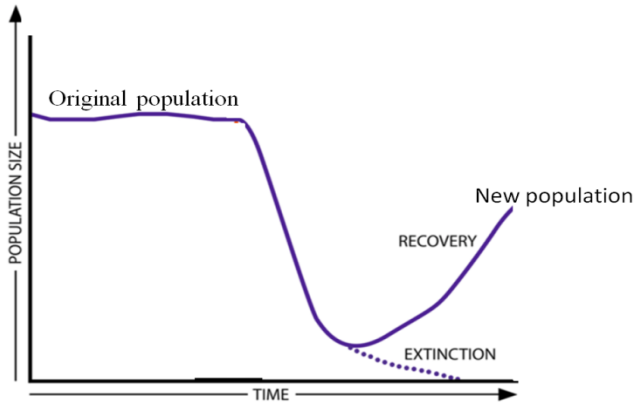
A 1

B 2

C 3

D 4

xi. When a type of deer is hunted almost to extinction, the resulting survivors form a population as shown in the graph below.



The new population will be

A genetically less diverse than the original population.

B genetically more diverse than the original population.

C the same as the original population.

D a different set of population.

xii. Initially, a TB patient was cured with antibiotics. However, during the second infection, the drug was found to be ineffective as the bacteria had developed a resistance to it. This is best explained by

A theory of inheritance of acquired characters.

B synthetic theory of evolution.

C theory of natural selection.

D theory of mutation.

xiii. Select the correct sequence of spermatogenesis.

A spermatogonium → spermatids → spermatocytes → spermatozoa

B spermatogonium → spermatocytes → spermatids → spermatozoa

C spermatids → spermatogonium → spermatocytes → spermatozoa

D spermatocytes → spermatogonium → spermatids → spermatozoa

xiv. Pema suffers from haemophilia, a condition that prevents blood clotting. If you were a doctor, which of the following treatments would you suggest?

A chemotherapy

B homeotherapy

C gene therapy

D physiotherapy

xv. The transfer of pollen from one flower to another flower borne on the same plant is called

A allogamy.

B autogamy.

C dichogamy.

D geitonogamy.

b) Match each item of Column A with the most appropriate item of column B. Rewrite the correct pairs by writing the number and corresponding alphabet in the spaces provided. **[5]**

Column A		Column B	
i.	Energy production in muscle contraction	a)	Aldosterone
		b)	Vasopressin
ii.	Reabsorption of salts	c)	NADP+ Reductase
iii.	Secretion of paneth cells	d)	Translocase
iv.	Digestion of carbohydrates	e)	Myosin ATPase
v.	Digestion of Fats	f)	RuBP Carboxylase
vi.	Light independent phase	g)	Trypsin
vii.	Reabsorption of water	h)	RNA polymerase
viii.	Shifting of ribosome on mRNA	i)	Lipase
ix.	Initiation of transcription	j)	Amylase
x.	Light dependent phase	k)	Lysozyme
		l)	Mucus

Column A	Column B
i.	
ii.	
iii.	
iv.	
v.	
vi.	
vii.	
viii.	
ix.	
x.	

c) Fill in the blanks with appropriate word(s). [5]

i.	The end product of glycolysis is _____.	
ii.	During polarised state of nerve impulse conduction, sodium ion channels remain _____.	
iii.	The fusion of diploid secondary nucleus and haploid male gamete results in _____endosperm.	
iv.	In C_4 pathway the CO_2 released in the bundle sheath cells enter _____ cycle.	
v.	The release of secondary oocyte from the matured graafian follicle is called _____.	
vi.	The genetic disorder treated by gene therapy in somatic cell is not _____.	
vii.	Rhizobium is used as _____ to fix nitrogen in the soil.	
viii.	In long bones, transverse transportation of food and oxygen take place through _____ canal.	
ix.	Bone marrow in the spongy bone which appears red is due to the presence of _____.	
x.	The different breeds of dog is an example of _____ diversity.	

d) Correct the following statements by changing the underlined word(s) only. [5]

Rewrite ONLY the correct word. DO NOT copy the whole sentence.

i. The final product formed in Krebs cycle is <u>citrate.</u>

ii. Peritubular capillaries around the Loop of Henle that take part in counter current mechanism is called <u>efferent arteriole</u>.

iii. Initial fixation of CO_2 in C_4 plants takes place in the <u>bundle sheath.</u>

iv. During <u>diplonema stage</u> of meiosis, an exchange of chromatid segments between non-sister chromatids takes place.

v. Conservation is the method of pest control through predator and prey relationship.

e) Answer the following questions.

i. Climate change is a threat to biodiversity. Do you agree? Support your stand with **TWO** reasons. **[1]**

ii. Lung fish is a connecting link between fishes and amphibians. Justify. **[1]**

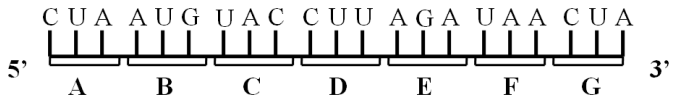
iii. Study the DNA profile of the suspects involved in a crime and answer the question. **[1]**

Which suspect should be charged with the crime?

iv. The zygote divides only after the division of a primary endosperm cell. **[1]**
Give **ONE** reason to support the statement.

v. The placenta forms a structural and functional unit between mother and foetus. Is having a placenta an advantage for the foetus. Do you agree? Justify. **[1]**

vi. Study the sequence of nitrogenous bases on the mRNA strand given below and identify the initiation point and termination point during protein synthesis. **[1]**



vii. The flow of gene between two populations may take place by hybridization. Explain. **[1]**

viii. What would happen if the medullary rays are removed from the plant? **[1]**

ix. Mention the role of Ca^{2+} ions during muscle contraction. **[1]**

x. The bird's wing and human arm are examples of homologous organ. Explain. **[1]**

SECTION B (60 MARKS)

*Attempt **ANY SIX** questions*

Question 2

a) i. Write the function of cellulose in plant cell walls. **[1]**

ii. Draw the structure of nucleus and label the following parts. **[2]**

nuclear pore, chromatin

b) i. What is chylomicron? **[1]**

ii. Give **ONE** difference between parenchyma and collenchyma cells. **[1]**

Parenchyma cells	Collenchyma cells

a) i. Study the table given below. **[1]**

Species	Community-1	Community-2	Community-3
X	0	25	55
Y	30	24	10
Z	40	21	5
Total	70	70	70

Which community displays the highest species diversity? Why?

i. Bhutan is considered as one of the most important biological hotspot. Do you agree? Justify. **[1]**

d) Give reasons.

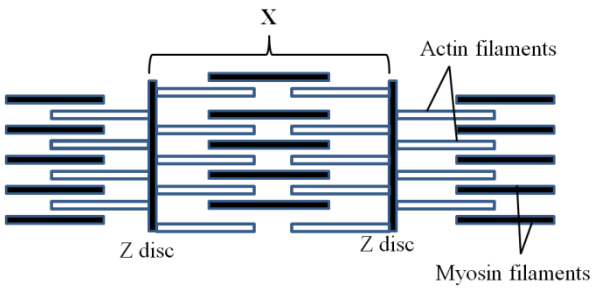
i. Ligaments connect two bones at the movable joints. **[1]**

ii. Adipose tissues act as an insulator. **[1]**

e) What is in-situ conservation? **[1]**

Question 3

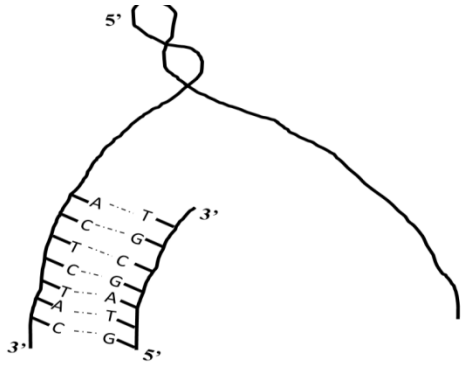
a) The figure given below shows a muscle fibre. Study the figure and answer the questions that follow.



i. Identify the part labelled X. **[1]**

ii. Draw the muscle in a contracted state. **[1]**

b) Study the diagram of DNA replication in 5' – 3' directions and answer the questions that follow:



i. Identify the error in the new strand and correct it with the help of a diagram. **[1]**

ii. If the corrected new chain of DNA is used as the template for the RNA segment, draw the nucleotide sequence on the mRNA segment. **[1]**

c) i. Differentiate between monocot and dicot leaves based on the given features. **[2]**

Feature	Monocot leaf	Dicot leaf
Mesophyll cells		
Presence of stomata in upper epidermis		

ii. Mention **ONE** function of endodermis. **[1]**

d) What is synaptic delay? **[1]**

e) How does DNA finger printing help to identify a child's father in paternity disputes? **[2]**

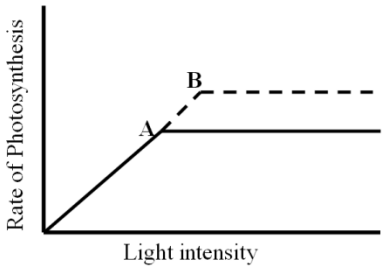
Question 4

a) Name the following.

i. Synthesis of ATP from ADP and inorganic phosphate in mitochondria. **[1]**

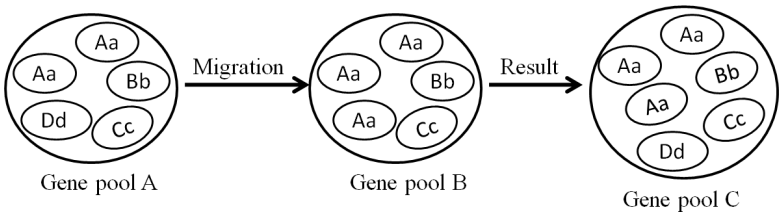
ii. Formation and development of embryo. **[1]**

b) The graph given below shows the effect of light intensity on the rate of photosynthesis at an optimum temperature. Suggest **ONE** way to increase the rate of photosynthesis from A to B. **[1]**



c) How does tetanic contraction of muscles help to lift objects heavier than our body weight? **[2]**

d) The given figure, shows that a new gene pool is formed through migration of individuals from gene pool A to B. Study the figure and answer the following questions.



i. What will happen to the gene pool of population C? **[1]**

ii. What relation can you draw between gene pool and genetic diversity? **[1]**

e) Gene therapy is a technique of transfer of working gene copy into specific cells of a patient for therapeutic purposes. However, the idea of gene therapy is controversial. What is your stand on this issue? Give at least **TWO** reasons. **[2]**

f) Why is there no evolution of oxygen during cyclic photophosphorylation? **[1]**

Question 5

a) Mention **ONE** function each for the following.

i. Semen **[1]**

ii. Middle piece of sperm **[1]**

b) One of the amino acids required for insulin production is alanine. However, during the process of copying information from DNA to mRNA, there was an error in base pairing that resulted in production of a different protein.

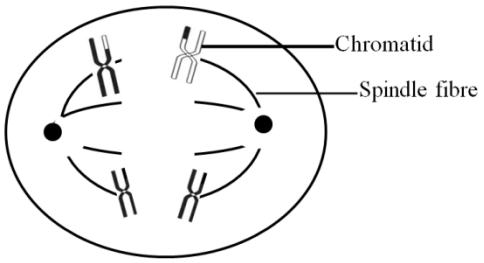
i. Name the process of copying information from DNA to mRNA. **[1]**

ii. Mention **ONE** disease that results from such an error. **[1]**

c) Ultrafiltration occurs in the Malpighian capsule which removes substances like urea, amino acid, creatine and so on from the blood during urine formation. Explain how the Malpighian capsule is structurally adapted to carry out ultrafiltration. **[2]**

d) The practice of community forestry is a good strategy of forest conservation for sustainable development. Justify. **[2]**

e) A cell undergoing meiotic cell division appears as shown in the diagram. Draw and name the phase before this stage. **[1]**



f) Why does a person feels excited after drinking alcohol? **[1]**

Question 6

a) Define the following.

i. Codon **[1]**

ii. Chiasmata **[1]**

b) i. Write down the role of bile in the digestion of fat. **[1]**

ii. According to Hardy-Weinberg equilibrium, the frequency of two alleles in a gene pool is 0.19 (A) and 0.81 (a). Calculate the percentage of heterozygous and homozygous individuals in a population. **[1]**

c) Usage of a chemical fertilizer and pesticide for intensive farming increases crop yield. Should such practices continue? Justify**.** **[2]**

d) The water in a tender coconut contains thousands of free nuclei surrounded by a white kernel. Use the information to answer the questions that follow.

i. What type of endosperm is represented by coconut water? **[1]**

ii. How are such endosperms formed? **[1]**

e) What is speciation? Explain Darwin's finches as an example of allopatric speciation. **[2]**

Question 7

a) A newborn's stool is yellowish in colour. Why? **[1]**

b) In glycolysis, the actual production of energy is 10 molecules of ATP, however, the net gain is 8 molecules of ATP. Explain. **[2]**

c) i. Origin of life was possible by chemical reactions through formation of simple and complex compounds on primitive earth. However, chemogeny does not occur in present day life, why? **[1]**

ii. What would happen if chemogeny occurs in present day earth? **[1]**

d) The toxic substances in peritubular capillaries and interstitial fluid are poured into the glomerular filtrate by the process called tubular secretion. However, in organisms having Bowman capsule the tubular secretion is not necessary. Comment. **[1]**

e) During biopoiesis, photoautotrophs started photosynthesising which brought about oxygen evolution. List down **TWO** effects of oxygen on evolution. **[2]**

f) Draw a diagram of an ovary and show the path of pollen tube towards the ovule in porogamy fertilization. **[2]**

Question 8

a) Mention any **FOUR** processes taking place during follicular phase of menstrual cycle. **[2]**

b) i. What is meiosis? **[1]**

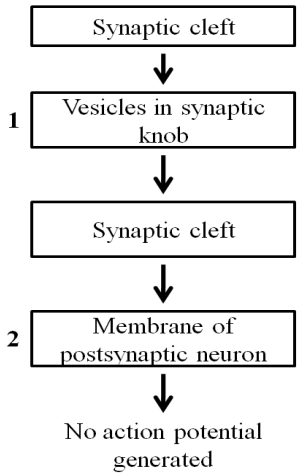
ii. Gametes are formed through meiosis. Comment. **[1]**

c) Differentiate between C_3 and C_4 plants based on the characteristics given in the table. **[2]**

Characteristics	C_3 plant	C_4 plant
1. Presence of chloroplast in bundle sheath cells		
2. Fixation of carbon dioxide (frequency)		

[2]

d) The flow chart given below shows synaptic transmission across a synapse. Study the chart and answer the questions that follow.



Calcium ions play an important role in synaptic transmission. If calcium ions are absent in synaptic cleft, mention the effect at site 1 and 2.

[2]

e) During the brewing of an alcohol, yeast is added to the substrate and the container is kept air tight for a certain period of time. Write the word equation of the chemical reaction taking place after glycolysis.
