SECTION A [40 MARKS]

ANSWER **ALL** QUESTIONS

Question 1

a) **Directions: 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 alternative. If there are more than one choice circled, NO score will be awarded.** **[25]**

i. Which ecological term best describes the figure below?

A population
B community
C ecosystem
D species

ii. Waste has become a significant challenge and a major contributor to environmental degradation. Which process can be used to convert kitchen waste into useful products?

A anaerobic digestion
B aerobic digestion
C combustion
D filtration

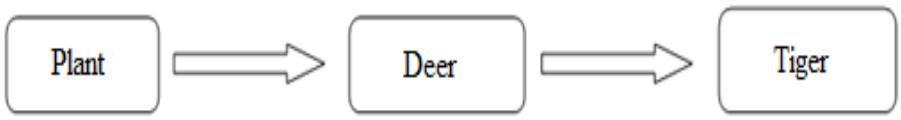
iii. Geographically defined areas which connect landscapes, ecosystems and habitats for the safe movement of wildlife between one protected area to another is referred to as biological corridors. Bhutan currently has nine such identified areas for the conservation of species. The purpose of the above is for

A the conservation of biodiversity.
B the conservation of plant species.
C in-situ conservation of biodiversity.
D ex-situ conservation of biodiversity.

iv. Botanists have learnt the applications of the basic principles of genetics to produce new varieties of plants with desired traits. Which of the following helps in the production of new varieties of plants with desired traits?

A use of pesticides
B selective breeding
C introducing new predators
D improved irrigation practices

v. The figure below shows a food chain representing number of organisms in each trophic level.



What would be the possible result, if the secondary consumer is wiped out due to some diseases?

A Deer will starve to death.
B There will be ample food for deer.
C The population of deer will decrease.
D Competition among deer will decrease.

vi. Hardy-Weinbery law states that, the frequency of all alleles of a particular gene in an ideal population remains constant for generations in the absence of disturbing factors. Which of the following will maintain equilibrium in a population?

A random mating
B small population
C natural selection
D migration of organisms

vii. Following are the events that occur during light and dark reactions of photosynthesis.

I. photolysis of water
II. activation of chlorophyll
III. reduction of carbondioxide

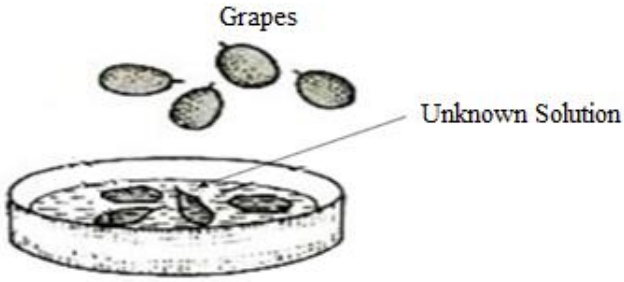
Arrange the above in correct order of events occurring during photosynthesis.

A I, II and III
B II, I and III
C III, II and I
D II, III and I

viii. Suppose a man with a genotype Tt for tall height marries a woman who is also Tt for this trait, what will be the probability of having offsprings with tall height?

A 25%
B 50%
C 75%
D 100%

ix. Upon dropping fresh grapes into an unknown solution, the grapes shrunk as shown in the figure below.



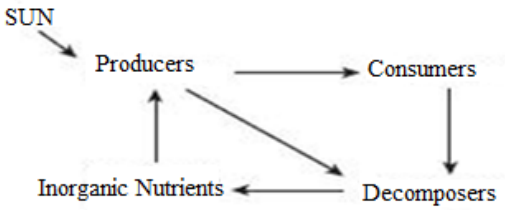
It can be concluded that the unknown solution was

A hypotonic.
B hypertonic.
C isotonic.
D distilled water.

x. 'The cell structure X of a bacteria performs the same function as the mitochondria of a plant cell'. X is

A capsule.
B plasmid.
C ribosome.
D mesosome.

xi. The figure shows a nutrient cycle in an ecosystem.



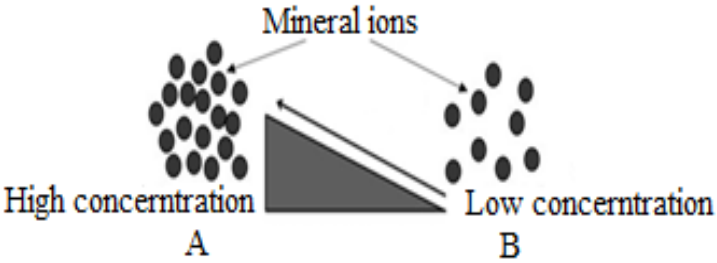
The removal of which of the organisms would directly reduce the amount of energy flow in the system?

A consumers
B decomposers
C producers
D inorganic nutrients

xii. Which of the following parts of a prokaryotic cell correctly matches with its function?

A cell wall- prevents dryness of cell
B capsule- locomotion and mobility
C pilus- fix to surface of substratum
D nucleoid- exchange DNA between bacterial cell

xiii. In the figure given below, 'A' represents the inside of root hair cells and 'B' represents region surrounding the root.



The process depicted in the diagram is

A osmosis.
B diffusion.
C active transport.
D facilitated diffusion.

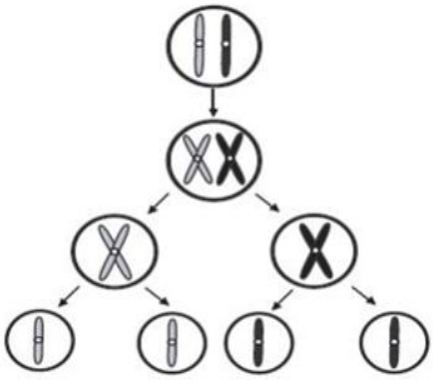
xiv. A student examines two bacterial cells, cell I and cell II. He finds that cell I produces carbon dioxide and ethyl alcohol during cellular respiration while cell II produces carbon dioxide and water. From his observation, it can be concluded that

A cell I undergoes aerobic respiration.
B cell II undergoes aerobic respiration.
C both cell I and II undergo aerobic respiration.
D both cell I and II undergo anaerobic respiration.

xv. Xylem tissue is made up of different types of cells. Identify the type of cell that provides strength to the plant body.

A vessel
B tracheid
C xylem fibre
D xylem parenchyma

xvi. Figure below shows a cellular process that takes place in organisms.



1- occurs in the gametes

2- produces haploids

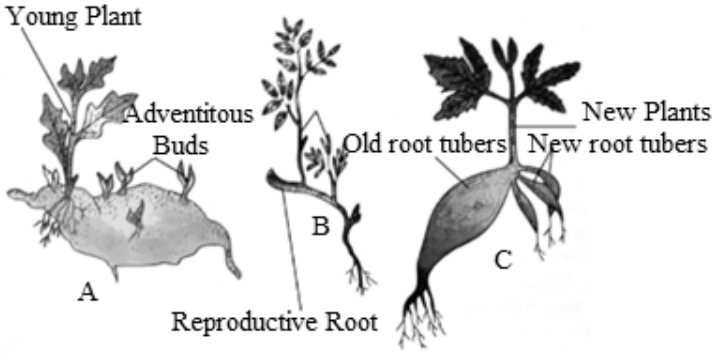
3- leads to variation

4- involved in wound healing

The correct order of process is

A 1, 2, 3 and 4.
B 1, 2 and 3.
C 1, 2 and 4.
D 2, 3 and 4.

xvii. The figure shows a technique used to propagate sweet potatoes. New root tubers (C) are formed asexually from the old root tubers (B).



If the cells of old tubers have 90 chromosomes, how many chromosomes will be present in the new tubers?

A 45
B 90
C 180
D 360

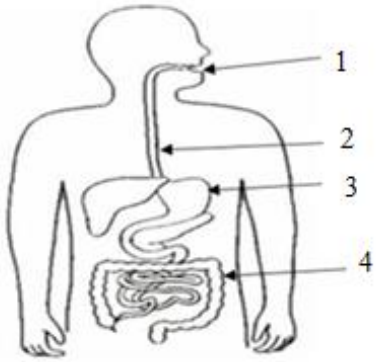
xviii. Increased tear production to clear objects from the eye and watering of mouth are the examples of

A conditioned reflex.
B acquired reflex.
C natural reflex.
D spinal reflex.

xix. Glucose is the main product formed during photosynthesis. Glucose is formed by the

A oxidation of carbon dioxide.
B reduction of carbon dioxide.
C reduction of water.
D photolysis of water.

xx. Figure shows the various digestive organs in a human body.



Identify the part that produces chyme.

A 1
B 2
C 3
D 4

xxi. If carbohydrates in the mouth are broken down by amylase, fats in the mouth are broken down by

A bile.
B lingual lipase.
C gastric lipase.
D hydrochloric acid.

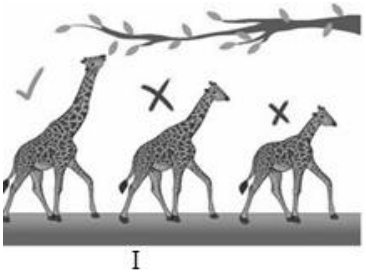
xxii. Among the various factors that determine the formation of new species, natural selection is one of them. Which of the following best describes natural selection?

A Organisms survive as a result of chance.
B Organisms move to a different place and breed.
C Organisms are separated by physical barriers forming new traits.
D Organisms with better traits tend to survive and breed successfully.

xxiii. Contraceptives are preventive methods to help a woman avoid unwanted pregnancies. All of the following are hormonal methods of contraception **EXCEPT**

A condom.
B vaginal ring.
C contraceptive pill.
D birth control shot.

xxiv. From the evolutionary point of view, organisms are also believed to have evolved as a result of genetic drift. Which of the following figures represents the evolution of species as a result of genetic drift?


I

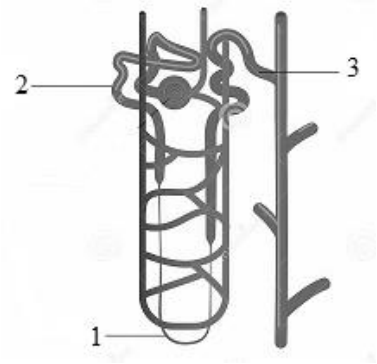

II


III


IV

A I
B II
C III
D IV

xxv. Figure below shows the structure of a nephron. The parts labelled 1, 2 and 3 are



A PCT, Loop of Henle and DCT.
B DCT, PCT and Loop of Henle.
C Collecting duct, PCT and DCT.
D Loop of Henle, PCT and DCT.

b) Fill in the blanks with appropriate word/s or phrase/s. [5]

i.	Skin cells are continuously being replaced through cell division called .....….....	
ii.	The structural and functional unit of kidney is.....	
iii.	If you take a meal containing high content of beans, your body cells will receive …… as the final product of digestion.	
iv.	The network of food chains is termed as….....	
v.	An animal breeder crossed two organisms with different traits to have an offspring with the desired traits using a certain procedure. The new offspring with the desired traits is termed as ….....	

c) State whether the following statements are TRUE or FALSE. [5]

i.	Munch mass flow model investigates the movement of food across the plant body.		
ii.	The dark reaction of photosynthesis occurs maximum at night.		
iii.	Suppose a bacterial cell has undergone one cycle of mitotic division and the daughter cells formed have further underdone another cycle of mitotic division, then the total number of bacterial cell produced will be 6.		
iv.	To manage kitchen wastes with the help of microbes requires anaerobic environment.		
v.	When the biconcave disc-shaped cell count in our body is less, the transport of carbondioxide is afffected.		

d) Match each item under Column A with the item in Column B. Rewrite the correct pairs by writing the alphabet against the number in the space provide. [5]

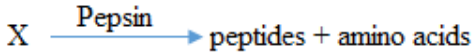
Answer	Column A	Column B	
	i. Universal recipient blood group	a. heterozygous offspring	
	ii. An ability of receptors to change one form of energy to another	b. osmosis	
	iii. WW x ww	c. diffusion	
	iv. Change in the allele frequency due to predation	d. AB	
	v. Regulates closing and opening of stomata	e. transduction	
		f. homozygous offspring	
		g. natural selection	

SECTION B [60 MARKS]

ATTEMPT **ANY SIX** QUESTIONS

Question 2

a) Use the equation given below to answer the questions that follow. **[1]**



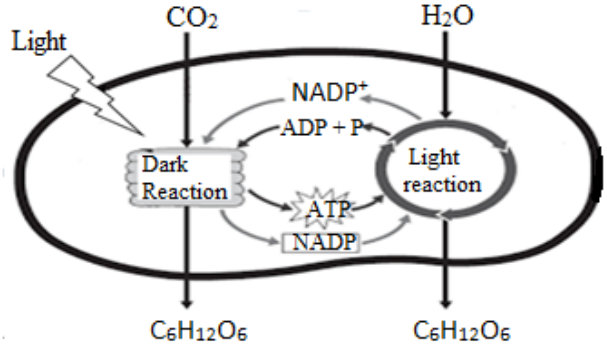
How does the production of HCl affect protein digestion?

b) A contractor plans to build road infrastructure for the benefit of the community located near a national park. According to the study, the road alignment will pass through the core protected area of the national park which is the habitat of the endangered Royal Bengal tiger.
Would you support such a developmental activity? Support your stand with **TWO** points. **[2]**

c) 'Natural selection has no favouritism'. Explain natural selection with an example. **[2]**

d) Answer the following questions.

i. One of the classmates illustrated the concept of light and dark reaction as given in the figure below. Re-design the illustration by making necessary changes in the diagram. **[2]**



ii. A monohybrid cross is carried out in homozygous tall [TT] pea plant and a homozygous short [tt] pea plant. All the offsprings produced in the F1 generation are heterozygous tall [Tt]. Work out the genotypic and phenotypic ratios of their offsprings in F2 generation. **[2]**

iii. Which of the following are examples of effectors? **[1]**
(skin, salivary gland, eye, ears, biceps and triceps)

Question 3.

a) Differentiate between prokaryotic and eukaryotic cell based on the **[2]**
i. size and
ii. composition of cell wall.

	Prokaryotic	**Eukaryotic**	
Size			
Composition of cell wall			

b) Why is detritus food chain equally important as grazing food chain? Support with **ONE** reason. **[1]**

c) Biodiversity provides humankind with many of the things that helps to sustain lives. Support the statement with any **TWO** reasons. **[2]**

d) Answer the following questions.

i. Define osmoregulation. **[1]**

ii. The figure below shows a part of nephron that helps in the formation of urine. Use the figure to fill up the table given below. **[2]**

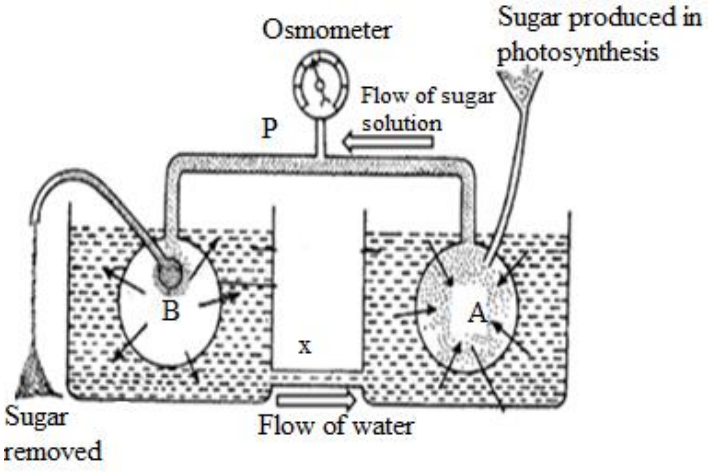
1.	Process of urine formation that occurs due to difference in the size of blood vessel I and II.	
2.	The composition of glomerular filtrate, if kidney is damaged.	

e) If you are one of the conservationist working in Royal Society for Protection of Nature, what measures would you implement to prevent the decline in the population of the endangered species, White-bellied Heron. List any **TWO**. **[2]**

Question 4

a) How is the rate of photosynthesis affected when the intensity of the light is very high? **[1]**

b) Figure below demonstrates the transport of food in plants. Answer questions i and ii with reference to the figure.



i. What do parts A and B represent in plants? **[1]**

ii. What role do glass tubes P and X play in plants? **[2]**

c) Define the following terms.

i. Sympatric species **[1]**

ii. Egestion **[1]**

iii. Chemical digestion **[1]**

d) Use the figure given below to answer questions i and ii.

i. Identify the factor that leads to the formation of new species of squirrels over time. **[1]**

ii. How will the identified factor lead to speciation over time? **[1]**

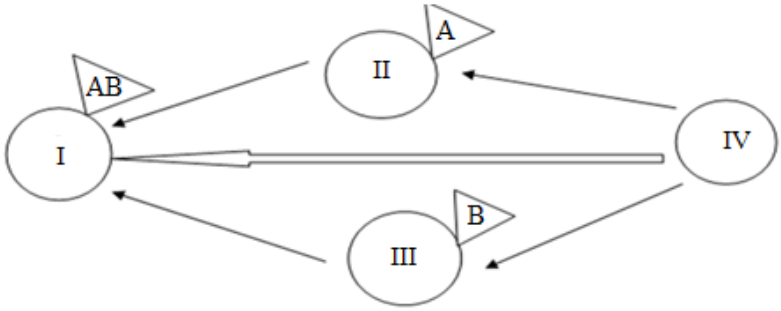
e) Define variation. **[1]**

Question 5

a) Though hormone therapy helps to address a range of issues associated with menopause in women, it has various side effects. Do you think such hormonal therapy should be practiced? Support your stand with **TWO** points. **[2]**

b) Osmosis is a process that helps in the movement of substances in and out of the cells. How do you think it is useful in our daily lives? Support with **TWO** examples**.** **[2]**

c) The figure below describes the relationship among different blood cells.

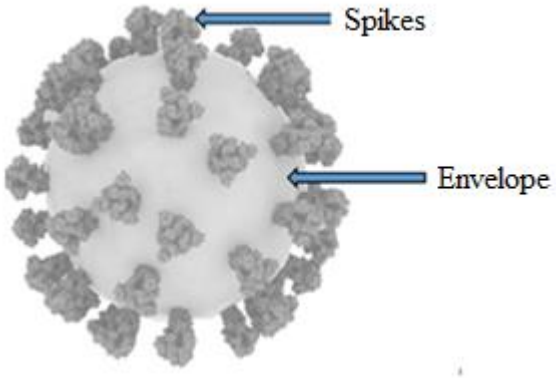


i. Identify the cell marked I and II. **[1]**

ii. What is the common name given to cell labelled IV? **[1]**

iii. What will be the consequence if the direction of the arrow between I and IV is reversed? **[1]**

d) Study the figure of a microorganism given below and answer the questions.

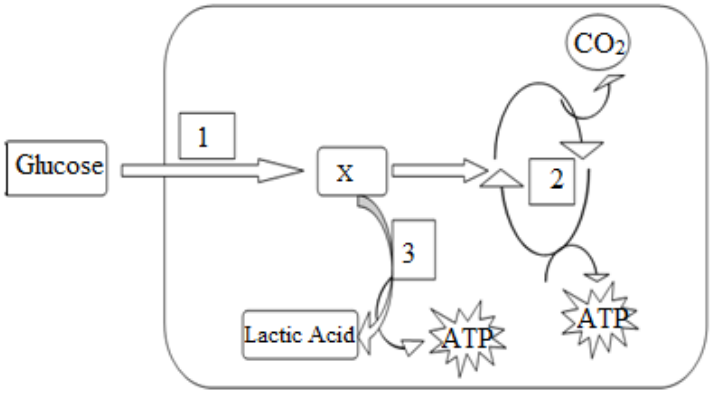


i. What characteristic of this microbe has alarmed scientists around the world over the emergence of new variants? **[1]**

ii. Identify the microbe. How is it different from bacteria? **[2]**

Question 6

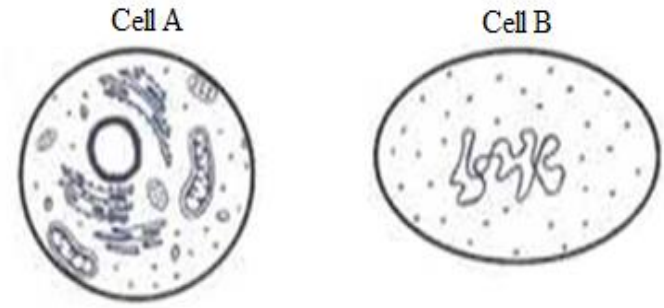
a) The figure given below shows a schematic representation of a physiological process that takes place in a human body.



i. Identify the processes 1 and 2. **[1]**

ii. Trace the correct sequence of pathways that occur during the working of muscles for a long duration. **[1]**

b) Which is a prokaryotic cell, cell A or cell B? Give **ONE** reason. **[1]**



c) In an environment that undergoes frequent change, species that reproduce sexually may have an advantage over species that reproduce asexually. Explain. **[2]**

d) Answer the following questions.

i. Given below are the enzymes that help in the digestion of food in a human body. **[2]**
(pepsin, erepsin, lipase, amylase)
List the enzymes under its correct category in the table below.

Fat digestion	**Protein digestion**	**Carbohydrate digestion**	

ii. Differentiate between afferent neuron and efferent neuron on the basis of their function. **[1]**

Afferent neuron	**Efferent neuron**	

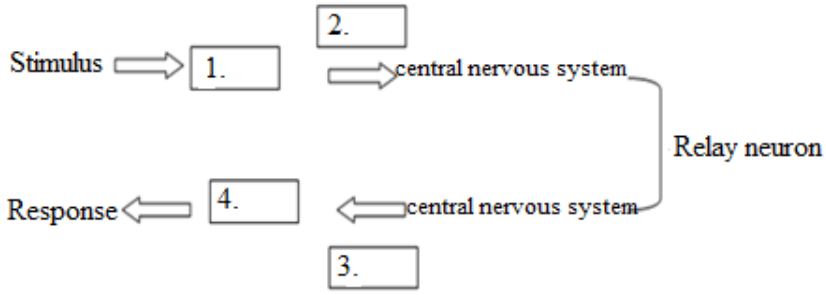
e) Human activities continue to place strain on the environment and one of the impact is the loss of biodiversity. Do you agree with the statement? Support your answer with **TWO** relevant reasons. **[2]**

Question 7

a) "Women are rarely colour blind." Support the statement with proper justifications. **[2]**

b) "Indoor plants have many benefits". Do you agree? Justify with **TWO** points. **[2]**

c) Provided below is a schematic diagram of a reflex arc. **[2]**



Arrange the following components of the reflex action to show the correct pathway of the nerve impulse in a reflex arc.
(motor neuron, sensory neuron, effector, receptor)

1.	
2.	
3.	
4.	

d) Differentiate between the following pairs based on the information given in the brackets.

i. Osmosis and active transport (use of ATP) **[1]**

Osmosis	**Active transport**	

ii. Plasmolysis and de-plasmolysis (direction of water movement) **[1]**

Plasmolysis	**De-plasmolysis**	

e) *These are small fragments of cells formed from giant cells present in the red bone marrow. They are oval or round structures, non-nucleated and float in the blood plasma.*

i. Identify the cell. **[1]**

ii. Name the hormone responsible for the production of the cell stated in i. **[1]**

Question 8

a) Name the following.

i. Group of plants that can photosynthesize in dim light. **[1]**

ii. Energy rich compound that provides electrons for the reduction of carbon dioxide to glucose. **[1]**

b) Using the concept of osmosis, explain how water is absorbed by the root hairs. **[2]**

c) A heterozygous tongue rolling male marries a homozygous recessive woman. Using a Punnett square, find the probability of the offsprings based on the following phenotypes. **[2]**

i. can roll their tongue

ii. cannot roll their tongue

d) Figure shows different types of waste produced.

Bottles

Plastics

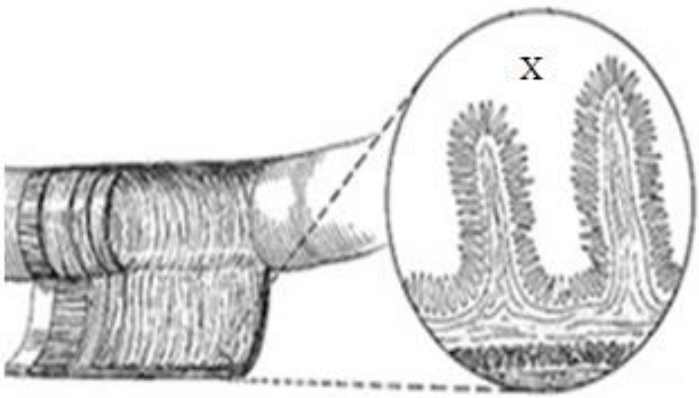
Kitchen waste

Electronic waste

i. Identify the type of waste that can be digested with the help of microbes. **[1]**

ii. Name the process involved in the digestion of the waste identified in i. **[1]**

e) The figure below shows the internal structure of a digestive organ. Study the diagram and answer the questions.

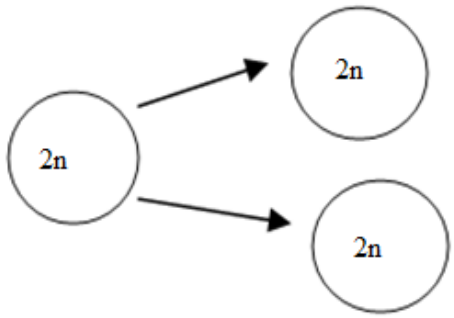


i. In which digestive organ is X present? **[1]**

ii. How does this structure help in the digestion of food? **[1]**

Question 9

a) Study the diagram of a cell division given below and answer the questions that follow.



i. In which type of cell does the above cell division occur? **[1]**

ii. List any **TWO** significance of the cell division. **[1]**

b) Explain how mitosis and meiosis differ on the following basis.

i. Genetic composition of the mother and daughter cells **[1]**

ii. Number of chromosomes seen in the daughter cell if the mother cell has 18 chromosomes **[1]**

c) Peacocks attract their mates with their tail feathers. The ones with the brightest and the largest tail mate more often. Explain how this would lead to evolutionary change within the species of peacocks over a long period of time. Include the following in your answer.

i. competition between the peacock population **[1]**

ii. survival of the type of peacocks in the population **[1]**

iii. expected change in the frequency of the peacocks with bright and large tails in the population of peacocks over a long period of time **[1]**

d) Read the excerpt given below and answer questions i. and ii.
'*Artificial selection has long been used in agriculture to produce animals and crops with desirable traits. The meats sold today are the result of the selective breeding of chickens, cattle, sheep and pigs. Many fruits and vegetables have been improved or even created through artificial selection. For example, broccoli, cauliflower and cabbage were all derived from the wild mustard plant through selective breeding'.*

i. How does artificial selection lead to evolution? **[1]**

ii. Do you foresee any problems in practising artificial selection? Support your answer with any **TWO** reasons. **[2]**