SECTION A [40 MARKS]
ANSWER **ALL** QUESTIONS

Question 1 **[25]**

a) For each question, there are FOUR responses: A, B, C and D. Choose the corresponding letter of your response and CIRCLE it neatly. NO score will be awarded if you circle more than ONE letter.

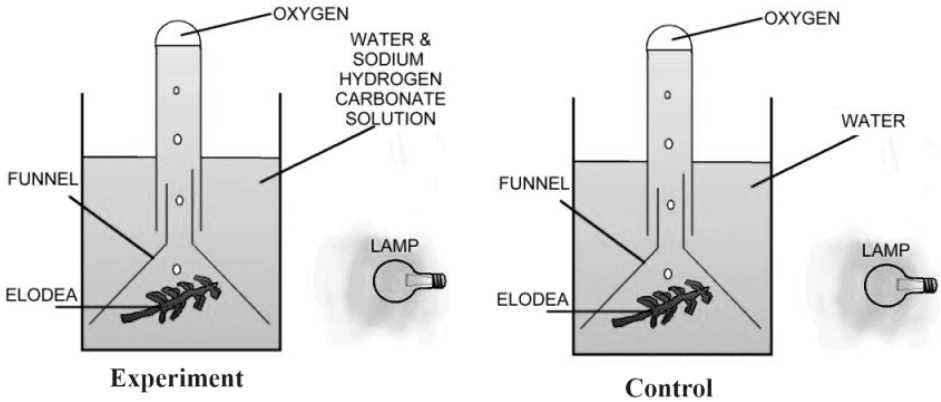
i. Which of the following cellular structures is absent in prokaryotic cell?

A Ribosome
B Mesosome
C Mitochondria
D Cell membrane.

ii. The statement that best describes the process of osmosis is that

A solute moves from low concentration to high concentration through a semipermeable membrane.
B solute moves from high concentration to low concentration through a semipermeable membrane.
C water moves from low solute concentration to high solute concentration through a semipermeable membrane.
D water moves from high solute concentration to low solute concentration through a semipermeable membrane.

iii. The figure below shows the experimental setup along with its control setup to study the effect of a particular factor on the rate of photosynthesis.



Which factor affecting the rate of photosynthesis is being investigated?

A Water
B Oxygen
C Light intensity
D Carbon dioxide.

iv. The phloem tissue which helps in storage of reserve food and conduction of food materials is

A phloem fibre.
B sieve element.
C companion cell.
D phloem parenchyma.

v. A patient has chronic pancreatitis leading to reduced secretion of pancreatic enzymes. Which of the following is the most likely result of this condition?

A Improved nutrient absorption in the small intestine
B Reduced digestion of carbohydrates, proteins, and fats
C Enhanced protein digestion due to oversecretion of trypsinogen
D Increased blood glucose levels due to enhanced insulin production

vi. What is the primary function of haemoglobin in red blood cells?

A Phagocytosis
B Clotting of blood
C Transport oxygen
D Transport nutrients.

vii. A researcher is interested to study a plant response to drought by investigating the effectiveness of a hormone that reduces the transpiration. Which synthetic hormone is likely to be effective to reduce transpiration?

A Ethylene
B Gibberellin
C Abscisic acid
D Naphthaleneacetic acid.

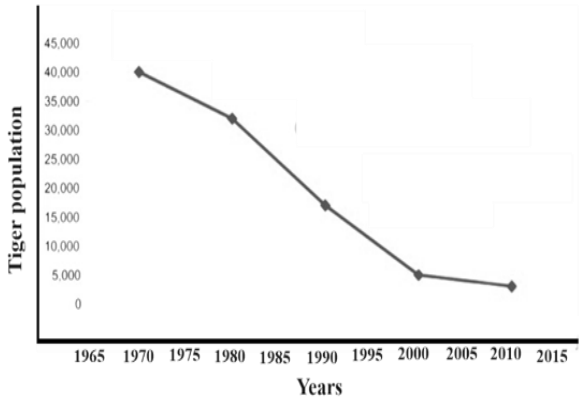
viii. Low physical activity is linked to kidney damage because it

A improves overall circulation which benefits kidney health.
B reduces the workload on the kidneys keeping them healthy.
C leads to obesity and hypertension which can damage kidney.
D increases blood flow to the kidneys improving their function.

ix. Which among the following microorganisms is linked to gastritis and stomach ulcer?

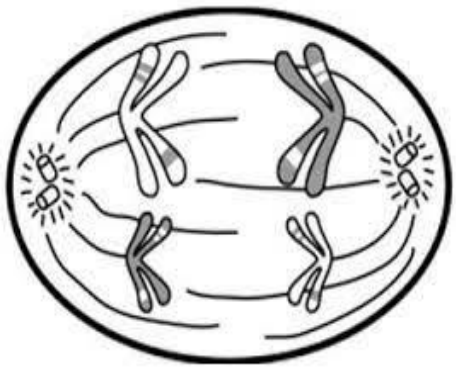
A *Escherichia coli*
B *Salmonella typhi*
C *Helicobacter pylori*
D *Staphylococcus aureus*

x. The graph below shows the change in population of tiger over the years. Study the graph and determine the most likely reason for the change in the population.



A Successful breeding programs in captivity
B Strict global enforcement of anti-poaching laws
C Poaching and habitat loss due to human activities
D Increased availability of prey and expanded habitats

xi. The figure below represents one of the phases of meiotic division.



Identify the phase

A Prophase I
B Prophase II
C Anaphase I
D Anaphase II.

xii. When two opposite alleles are present in an organism, one allele can mask the expression of the other allele. This phenomenon is described as

A crossing over
B law of dominance
C law of segregation
D law of independent assortment.

xiii. In a forest, there exist a population of white and black rabbits. The forest is mostly covered in dark soil with patches of white snow during winter. Over the past few decades the climate has been warming causing the duration of snow cover to decrease each year.
Given the change in climate, which colour of rabbit(s) is likely to thrive?

A Both colours will thrive
B White because it will be advantageous during the winter
C Black because it provides better camouflage in the dark soil
D There will be no effect of climate change on rabbit population

xiv. The primary goal of using DNA recombinant technology in breeding is to

A increase the population size.
B eliminate all genetic mutations.
C create genetically identical organisms.
D introduce desirable traits and diversity.

xv. Which of the following best describes gene flow?

A Selection of advantageous traits
B Isolation of different populations
C Random changes in allele frequencies
D Exchange of alleles between populations

xvi. The following processes occur during photosynthesis.

I Reduction of carbon dioxide
II The splitting of water
III The synthesis of glucose
IV Formation of ATP

The sequence of events that occurs during the light reaction is

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

xvii. Unhealthy dietary habits such as overeating fatty or processed foods and neglecting a balanced diet may lead to numerous health problems.
What is the primary disadvantage of diets heavily reliant on processed food?

A Rich in natural antioxidants that promotes overall health
B Contain additives that leads to lifestyle disease
C Low in calories and help maintain a healthy weight
D Provide a balanced amount of essential nutrients required for body growth

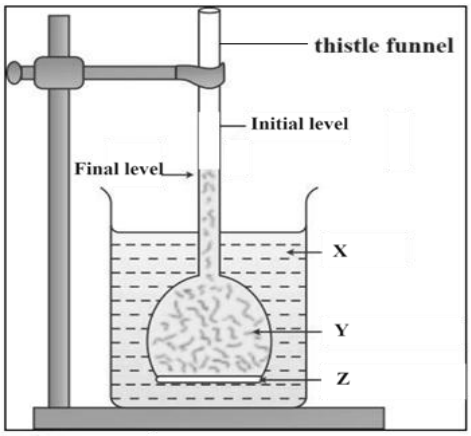
xviii. Which of the following shows an interaction between a biotic and an abiotic component?

A Rabbit eats grass
B Lion hunts a zebra
C Tree grows in the soil
D Bird builds its nest on a tree

xix. Mitosis is the cell division which involves

A germ cells to create genetically different cells.
B germ cells to create genetically identical cells.
C somatic cells to create genetically different cells.
D somatic cells to create genetically identical cells.

xx. The experimental set up shown below is used to investigate the process of osmosis. The set up was kept for 1 hour under observation.



Which of the following correctly matches with the parts labeled X, Y and Z?

A X-concentrated solution, Y-dilute solution, Z- freely permeable membrane.
B X- dilute solution, Y-concentrated solution, Z-freely permeable membrane.
C X-concentrated solution, Y-dilute solution, Z- selectively permeable membrane.
D X-dilute solution, Y-concentrated solution, Z- selectively permeable membrane.

xxi. Karma accidentally touches the hot stove and instantly pulls his hand away. Which sequence best describes the pathway involved in this response?

A Receptor → Interneuron → Sensory neuron → Motor neuron→ Effector
B Receptor → Sensory Neuron → Motor Neuron → Interneuron→ Effector
C Receptor → Sensory Neuron → Interneuron → Motor Neuron →Effector
D Receptor → Motor Neuron → Sensory Neuron →Interneuron → Effector

xxii. Which of the following is an example of ecosystem diversity?

A Different breeds of dogs
B Forest, desert, and lakes
C DNA variations in a population
D Various species of birds in a forest

xxiii. A person who frequently consumes spicy food may experience gastritis, leading to reduced secretion of gastric enzymes. This could lead to

A decreased breakdown of starch in stomach.
B impaired secretion of bile by the gallbladder.
C decreased breakdown of proteins in the stomach.
D reduced absorption of nutrients in the small intestine.

xxiv. What is the role of NADPH in the dark reaction of photosynthesis?

A Reduces carbon dioxide to glucose
B Provides energy for synthesis of glucose
C Transports carbon dioxide to chloroplasts
D Breaks down glucose into simpler molecules

xxv. A homozygous red flower plant is crossed with a homozygous white flower plant. If red allele is completely dominant over the white allele, the phenotype of offspring would be

A 50% red flower
B 100 % red flower
C 50% white flower
D 100% white flower

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

i.	The movement of photosynthetic product through phloem is called _____	
ii.	A person with blood group A lacks _____antibody in their plasma.	
iii.	The part of nephron which is permeable primarily to water is _____ loop of Henle.	
iv.	The severe storm caused a significant reduction in the rabbit population, leading to a reduction in genetic diversity. This is an example of _____ effect.	
v.	Natural selection has led to a higher prevalence of sickle cell trait in regions where _____ is endemic.	

c) Write TRUE or FALSE for the following statements in the space provided in the 'Answer' column. **[5]**

i.	Increase in the intensity of light generally results in a higher rate of photosynthesis, regardless of other factors.		
ii.	The microvilli in the small intestine increase the surface area for nutrient absorption.		
iii.	Natural reflexes involve the brain in its initial response pathway.		
iv.	Bhutan's ecosystem supports many endangered species due to its diverse range of habitats.		
v.	Genetic variation in offspring is increased by meiosis but not by mitosis.		

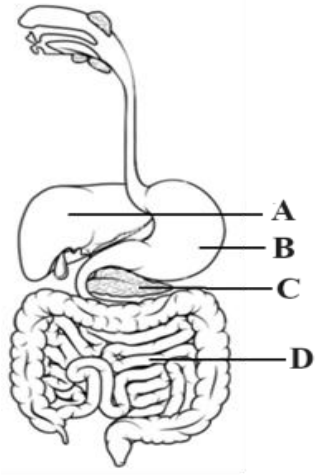
d) Match each item in Column A with the most appropriate item in column B. Write the correct letter in the space provided in the 'Answer column. **[5]**

Column A		Column B	Answer	
i.	Storage of genetic information in prokaryotic cell	a. Facilitated diffusion	i.	
ii.	Requires carrier proteins to transport materials	b. Genetic modification	ii.	
iii.	Use of microorganism to treat waste water	c. Nucleoid	iii.	
iv.	Introduction of foreign DNA into an organism	d. Bioremediation	iv.	
v.	Express only in homozygous form	e. Recessive allele	v.	
		f. Simple diffusion		
		g. Nucleus		

SECTION B [60 MARKS]
ATTEMPT **ANY SIX** QUESTIONS

Question 2

a) Study the figure given below and answer the questions that follow.



i. Label the parts **A** and **C** **[1]**

A:	
C:	

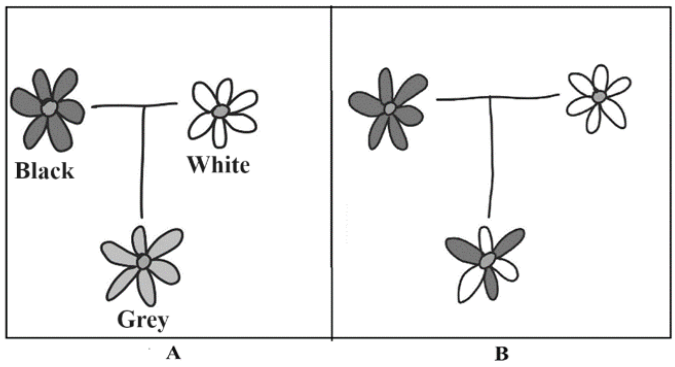
ii. Describe any **ONE** structural adaptation of the part labelled **D**. **[1]**

iii. What is the role of hydrochloric acid present in the part labelled **B**? **[1]**

b) In an ecosystem, some snails have thick shells and some have thin shells. Birds that prey on these snails find it easier to break the thin shells. Over time, the birds' population decreases, reducing predation pressure.

How might the decrease in bird population change the allele frequency of thin shelled snails? Explain. **[2]**

c) The figure below shows inheritance pattern in flowers with different colour. Study the figure and answer the following questions.



i. Identify the inheritance pattern. **[1]**

A:	
B:	

ii. How does the inheritance pattern shown in the figure differ from Mendelian inheritance pattern? **[1]**

d) In a rural community, farmers faced declining corn yields due to pests and climate change. They decided to use hybrid corn seed to overcome this problem. Do you think the farmers have taken the right decision? Justify. **[2]**

e) What is the role of chlorophyll in photosynthesis? **[1]**

Question 3

a) Anabolic steroids are known for their ability to promote muscle growth, enhance physical performance and increase body mass. Despite these benefits, why do you think the use of anabolic steroids by athletes is banned during competitions? **[2]**

b) Draw a diagram of a prokaryotic cell and label the part that is unique to prokaryotic cells and is not found in eukaryotic cells. **[2]**

c) Mention any **TWO** strategies adpoted by Bhutan to conserve biodiversity? **[2]**

d) Mutation leads to the formation of new species. Justify. **[1]**

e) There is a breed of local cattle that is resistant to diseases and a breed of hybrid cattle that yields more but is susceptible to diseases.
As a biotechnologist, how would you use the knowledge of genetic engineering to create high-yielding cattle that are resistant to diseases? **[2]**

f) The health of an ecosystem depends on its biodiversity. Justify with **ONE** reason. **[1]**

Question 4

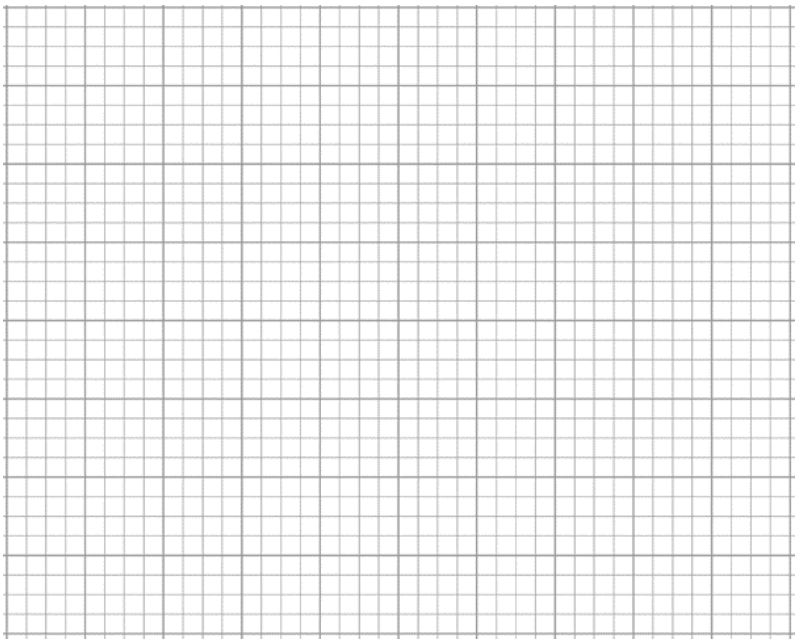
a) Many bacteria present in our body are beneficial. Justify with a reason. **[1]**

b) A student cuts out six cubes of potato. Each potato square is 4cm3. The potato cubes are placed in sugar solutions of different concentrations. After one hour, the size of poatato cubes are measured again. The results are shown in the table.

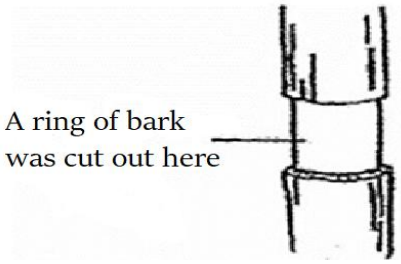
Solution	Concentration of sugar (gram/100ml)	Initial size	Final size
A	5	4 cm^3	6 cm^3
B	10	4 cm^3	5 cm^3
C	15	4 cm^3	4 cm^3
D	20	4 cm^3	3 cm^3
E	25	4 cm^3	2 cm^3
F	30	4 cm^3	1 cm^3

i. Which solution is isotonic? Give reason. **[1]**

ii. Plot a line graph showing final size of potato cube size against the concentration of sugar. **[2]**



c) A student conducted ring experiment by removing a section of bark completely around the stem as shown in the figure. The experimental set up was kept under observation for a few months. Answer the following questions based on the observations.



i. Draw a diagram showing the expected experimental results after a few months and explain your interpretation. **[2]**

ii. Why are plant leaves considered as a source? **[1]**

d) If a diploid cell of an organism has 12 number of chromosomes, how many chromosomes does each daughter cell has after meiosis? Show your work. **[2]**

e) Meiosis I is known as reduction division? Justify. **[1]**

Question 5

a) You are residing in a high-altitude location and want to improve vegetable productivity in your locality. As a science student, how will you adjust the factors affecting the rate of photosynthesis to maximixe the vegetable productivity? **[3]**

b) Anaerobic digestion is used to improve human diet. Justify the statement with **TWO** reasons. **[2]**

c) When organisms are isolated, they are not able to reproduce. They eventually become different species. **[2]**

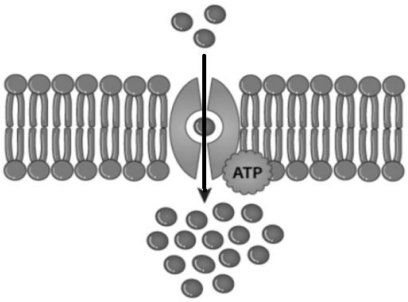
Read the situations provided below and determine the type of isolation for each situation.

Situation A: Two species of lizards live in the same desert but occupy different habitat. They rarely encounter each other and do not interbreed.

Situation B: A species of bird is divided into two populations when a large storm splits its island in two parts. Over time, the birds on each island develop distinct traits due to their isolation.

Situation A:
Situation B:

d) Membrane transport regulates the passage of solutes such as ions and small molecules through cell membrane. Identify and explain the type of membrane transport shown in figure below. **[2]**



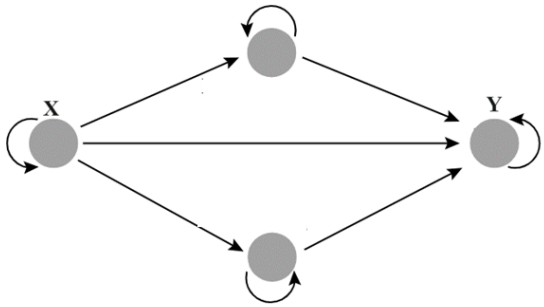
e) Compare the chromosome in haploid cell and diploid cell. **[1]**

Question 6

a) When the roots of a green plant are immersed in concentrated saltwater, the leaves of the plant wilts. Justify. **[1]**

b) What is in-vitro fertilization? Write its significance. **[2]**

c) The figure shows the blood donor and receipient. Study the figure and answer the questions that follow.



i. Identify the blood group labelled X and Y. **[1]**

X:	
Y:	

ii. Which blood group is considered as universal receipient? Why? **[2]**

d) Read the excerpt given below and answwer the questions i and ii.

"The polka dot plant, first reported in Khempagang village of Tading Gewog in October last year, has spread to five more Gewogs in Samtse. Recognising the serious threat posed by this invasive species, the National Plant Protection Centre conducted a one-day awareness programme in Tendu on Wednesday during the International Biological Diversity Day." (Source: Kuensel, May 24, 2024)

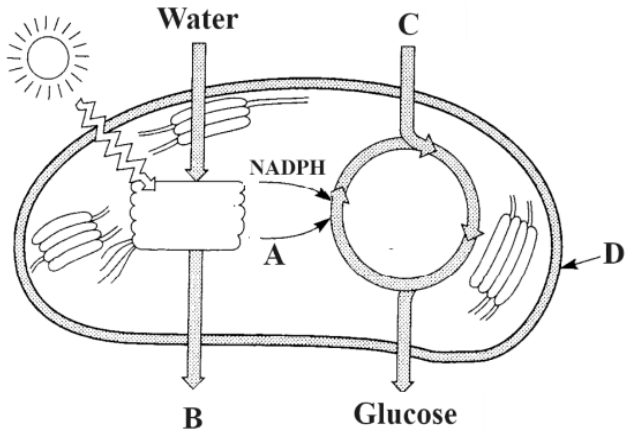
i. What do you understand by term "invasive species"? **[1]**

ii. What happens if such awareness programs are not conducted? **[1]**

e) Mention any **TWO** effective strategies for reducing HIV stigma in your community? **[2]**

Question 7

a) The figure given below shows a photosynthetic reaction. Study the figure and name the parts labelled A, B, C and D. **[2]**



A:	
B:	
C:	
D:	

b) List down any **TWO** unhealthy dietary practices in your community that can lead to kidney dysfunction. **[1]**

c) Draw the diagram of nephron and label the parts Bowman's Capsule, Distal convoluted tubule, Loop of Henle and Glomerulus. **[3]**

d) In a population of insects exposed to a particular pesticide, some may undergo mutation that provides resistance to the pesticide while others are eliminated.

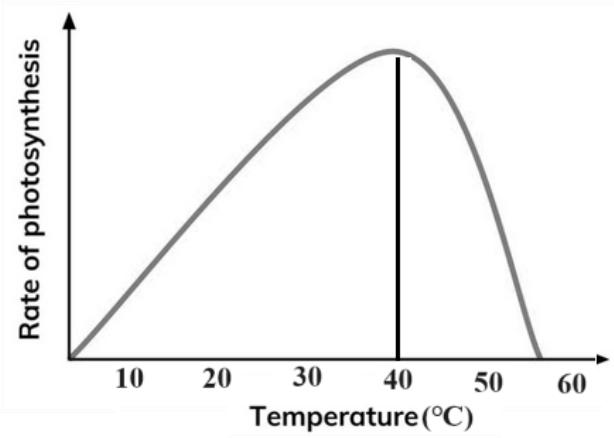
i. What evolutionaty process is decribed above? **[1]**

ii. Do you think the use of pesticide is a good method to control the pest? Explain. **[1]**

e) Two sperm cells from the same individial have different genetic composition. Explain your understanding. **[2]**

Question 8

a) A student conducted an experiment to determine how varying temperatures influence the rate of photosynthesis in an aquatic plant. The data obtained from the experiment is represented in a graphical form as shown below. Study the graph and answer the questions i and ii.



i. Identify the independent and dependent variable. **[1]**

Independent variable:	
Dependent variable:	

ii. Determine the temperature at which the rate of photosynthesis is maximum. **[1]**

b) State a function of blood platelet. **[1]**

c) A woman who is a carrier for colour blindness (XX°) marries a man with normal vision (XY).

i. What percentage of their offsprings will be normal? Show your understanding using Punnett square. **[1]**

ii. Why are X linked traits more common in male than in female? **[1]**

d) The extraction of natural resources is crucial for a country's development. However, it often results in the destruction of biodiversity.
Is it wise to extract natural resources for developmental activities? Justify. **[2]**

e) What do you mean by endangered species? **[1]**

f) Why is Hardy-Weinberg equilibrium essential in understanding evolutionary change in a population? **[2]**

Question 9

a) If junk food is banned in schools, it may encourage healthy eating habits among students. Do you agree or disagree with this statement? Provide reasons for your answer. **[2]**

b) Give reason for the following statements.

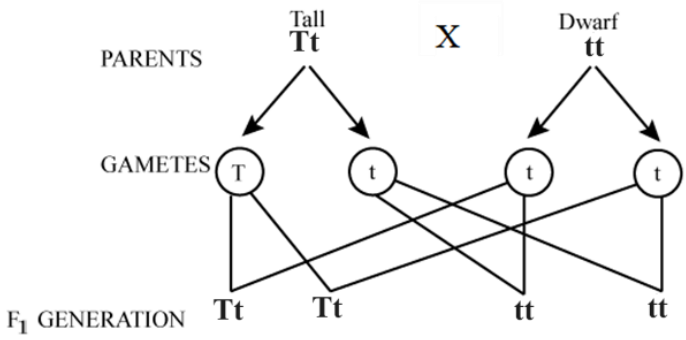
i. RBCs do not contain nucleus. **[1]**

ii. A person with blood group A cannot donate blood to a person with blood group B. **[1]**

c) The human nervous system functions in a similar way as a computer. Relate the parts of computer given below with the nervous system. **[2]**

1) CPU:	
2) Keyboard:	
3) Monitor:	
4) Hard disk:	

d) When a tall pea plant is crossed with a dwarf pea plant, the F1 generation is obtained. Answer the following question based on the figure given below.



i. Determine the genotypic ratio and phentypic ratio of F1 generation. **[1]**

Genotypic ratio:	
Phenotypic ratio:	

ii. If two heterozygous tall pea plants are crossed, what percenatge of the offsprings will be tall? **[1]**

e) During the COVID-19 pandemic, people encountered numerous challenges. How can we better prepare for such outbreaks in future to ensure safety and well-being? **[2]**

