SECTION A (40 marks)

*Answer **all** questions.*

Question 1.

(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 alternative. If there are more than one circled alternatives, NO score will be awarded. **[15]**

(i) The opening of the oesophagus into the stomach is regulated by the

A pyloric sphincter.

B cardiac sphincter.

C epiglottis.

D gullet.

(ii) The double walled cup like structure of a nephron is the

A proximal convoluted tubule.

B distal convoluted tubule.

C Bowman's capsule.

D Malpighian capsule.

(iii) What is the name of the enzyme which helps to dissolve the cell wall during the isolation of DNA in a plant cell?

A Chitinase

B Cellulase

C Pectinase

D Ligase

(iv) An electron microscope is preferred over a compound microscope in the study of the ultra structure of a cell because

A it forms an image on the photographic film.

B electrons travel in straight lines.

C it has a high resolution power.

D it uses high speed electrons.

(v) At the end of Kreb's cycle, glucose molecule is completely oxidized to

A CO and O_2.

B CO_2 and O_2.

C CO and H_2O.

D CO_2 and H_2O.

(vi) The conduction of nerve impulse through myelinated neuron is faster than non-myelinated neuron because

A nerve impulses need not travel through the entire length of axon.

B non-myelinated neurons have less neurotransmitter.

C myelinated neurons have less neurotransmitter.

D node of Ranvier provides insulation.

(vii) A farmer practices modern agricultural method to cultivate crops without allowing the soil to recoup. After a few years, he observes the yield of his crops are less compared to before. His yield dropped due to

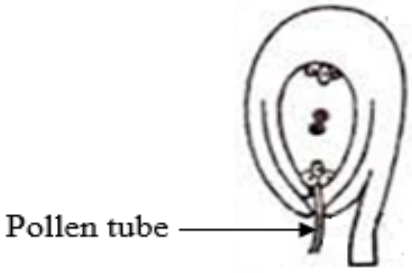
A passive adaptive management practices.

B unsustainable cropping practices.

C adaptive management practices.

D strategic management practices.

(viii) The figure given below represents the entry of a pollen tube into the ovule.



The figure shows

A chalazogamy.

B misogamy.

C porogamy.

D syngamy.

(ix) The number of chromosomes present in a normal human primary spermatocyte is

A 23.

B 24.

C 46.

D 48.

(x) All the factors listed below affect the opening and closing of stomata **EXCEPT**

A light.

B water.

C oxygen.

D minerals.

(xi) The lengthening of roots and shoots are due to the activities of

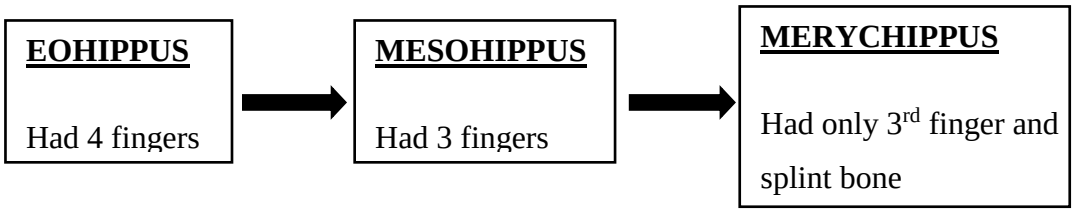
A intercalary meristem.

B axillary meristem.

C lateral meristem.

D apical meristem.

(xii) The chart below shows the stages in the evolution of horse.



The change in the number of fingers of a horse in a specific direction exhibits an evolutionary

A relationship.
B sequence.
C history.
D trend.

(xiii) During an experimental study, a mouse was exposed to UV rays. It was found that a codon GCA mutated to form GCT which codes for the same amino acid. This is an example of

A same-sense mutation.
B nonsense mutation.
C missense mutation.
D gross mutation.

(xiv) Which form of natural selection is exhibited by industrial melanism as observed in moths?

A Directional
B Stabilising
C Disruptive
D Artificial

(xv) Red drop or Emerson's first effect is when the quantum yield

A decreases sharply beyond the red region of the spectrum.

B increases sharply beyond the red region of the spectrum.

C decreases sharply beyond the blue region of the spectrum.

D increases sharply beyond the blue region of the spectrum.

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

(i) The …….. of excess amino acid in the liver produces pyruvic acid and ammonia.

(ii) The deficiency of …….. hormone causes the production of large quantities of dilute urine.

(iii) In plant cells …….. acts as a proton acceptor during photosynthesis.

(iv) In DNA strand synthesis,……..strand is synthesized in the 5´ ⟶3´direction.

(v) Each pair of synapsed homologous chromosomes formed during the zygotene stage of meiosis are called ……...

(vi) After ovulation, the mature Graafian follicle forms a large mass of yellow cells which releases ……...

(vii) The fusion of one of the two male gametes with the egg nucleus to form a zygote is called ……

(viii) Microorganisms used to deliver the desired gene into cells are known as ……..

(ix) Isobilateral leaves with stomata on both surfaces are called ……. leaves.

(x) The irreversible state of contraction of muscles is called ……

(c) ***Match each item of Column A with the most appropriate item of Column B. Rewrite the correct pairs by writing the alphabet against the number in the spaces provided.*** **[5]**

Column A	**Column B**
(a) acrosome of sperm	(i) Myosin filament
(b) apple	(ii) Thylakoid
(c) NADPH synthase	(iii) Golgi complex
(d) chloroplast	(iv) Mitochondrion
(e) incomplete break down of fo	(v) Chlorenchyma
(f) maize	(vi) Collenchyma
(g) middle piece of sperm	(vii) Anemophilous
(h) oxidation of food	(viii) Entomophilous
(i) cells with thick wall	(ix) Anaerobic respiration
(j) primary myofilament	(x) Cellular respiration
(k) cells having chloroplast	
(l) secondary myofilament	

Column A	
a)	
b)	
c)	
d)	
e)	
f)	
g)	
h)	
i)	
j)	

(d) Correct the following statement by changing the underlined word only. Rewrite ONLY the correct answer. DO NOT copy the whole sentence. **[5]**

(i) In centrifugation of homogenised cell, the homogenate sediments settle at the bottom of the tube.

(ii) Angiotensinogen produced by the pancreas helps the kidney to maintain body fluids.

(iii) The breakage of non-sister chromatids of a tetrad during crossing over is caused by the enzyme ligase.

(iv) The formation of new and distinct species in the course of evolution is called overspecialization.

(v) Antibodies are antiviral proteins produced against viral infection.

(e) Answer the following questions.

(i) Define the following terms: **[2]**

(a) Refractory period

(b) Synaptic fatigue

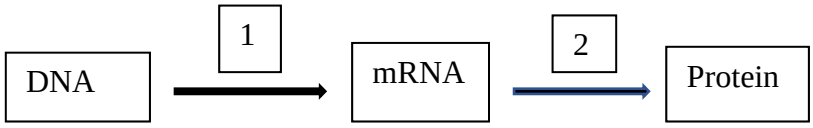
(ii) 'Farmers practice intercropping which a modern version is of traditional mixed cropping.' Why? Give **TWO** reasons. **[1]**

(iii) What is nephric filtrate? **[1]**

(iv) What happens to the stomata when the concentration of hydrogen ions in the guard cell increases? **[1]**

(v) What is photo-oxidation of chlorophyll in photosynthesis? **[1]**

(vi) The figure given below shows the one-way flow of information for protein synthesis. What are the parts labelled 1 and 2 to complete the sequence of events? **[1]**



1	
2	

(vii) 'Living organisms exhibit the reappearance of ancestral characteristics'. Give **ONE** evidence of evolution to show Dollo's law in support of descent with modification. **[1]**

(viii) 'Farmers deliberately burn vegetation in an area as an effective agriculture management tool'. Write down **TWO** advantages of this practice. **[2]**

SECTION B (60 marks)

*Answer any **SIX** questions.*

Question 2

(a) (i) Write the role of permease in a cell membrane. **[1]**

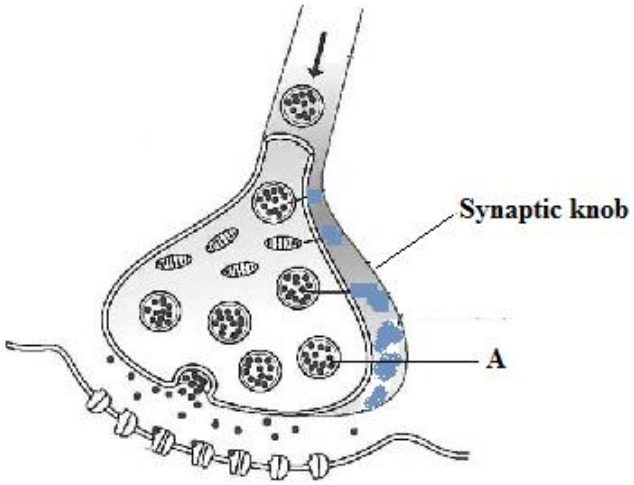
(ii) What is diapedesis of monocyte? Explain. **[1]**

(b) (i) What is Rouleaux formation? **[1]**

(ii) When does leucocytosis occur? **[1]**

(iii) What is disjunction in meiosis? **[1]**

(c) The transmission of impulse from one neuron to the next neuron occurs through the synapse which is shown below in the diagram. Study the same and answer the questions that follow.



(i) What is the role of the part labelled 'A' during the transmission of impulse? **[1]**

(ii) Neurotransmitters are always present in the axon terminals. Comment on the direction of conduction of nerve impulse in the adjoining neurons. **[1]**

(iii) Mention **TWO** drugs that interfere with the neurotransmission at the synapse. **[1]**

(d) 'Despite the large potential for the use of biomass, many countries of the world including Bhutan are not ready to rely exclusively on biomass for its energy supply'. Write down **TWO** limitations in the production of biomass energy. **[2]**

Question 3.

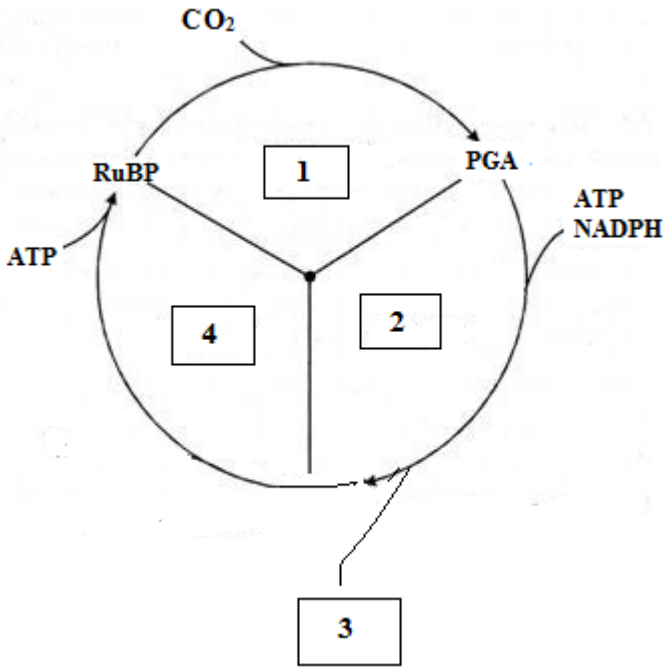
(a) (i) What is reduction division? **[1]**

(ii) Why skeletal muscle is called striated muscle? **[1]**

(iii) Explain insertion of muscles. **[1]**

(b) (i) Which enzyme is catalysis in the conversion of Ribulose 1, 5- biphosphate to 3- phosphoglycerate? **[1]**

(ii) The diagram below shows the three stages of Calvin cycle. Study the diagram and answer the questions that follow.



Label the parts numbered 1, 2, 3 and 4. **[2]**

Number	Part
1	
2	
3	
4	

(c) 'The advancement of DNA sequencing methods has greatly accelerated biological and medical research'. Do you agree? Justify. **[2]**

(d) 'According to the International Union for the Conservation of Nature and Natural Resources (2004), the total documented eukaryotic species with scientific names are 1.75 million but there is no estimated figure given for the prokaryotic'. Give **TWO** reasons. **[2]**

Question 4.

(a) Define the following terms:

(i) RNA splicing **[1]**

(ii) Tubular reabsorption **[1]**

(b) Explain briefly what happens to the water molecule and its product during non-cyclic photophosphorylation. **[2]**

(c) In angiosperms, the endosperm develops in three different ways as shown in figures A, B and C. Identify the different developmental types. **[3]**

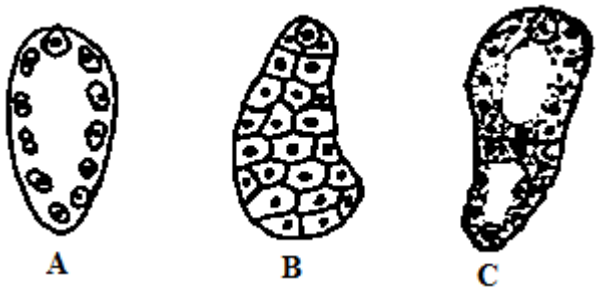


Figure	**Developmental type**
A	
B	
C	

(d) 'Species is a term difficult to define in a way that can be applied to all living organisms'. There are different criteria put forward by the biologist to define species. Write ***THREE*** criteria. **[3]**

Question 5.

(a) (i) What is succus entericus? **[1]**

(ii) Explain the chemical digestion of rice in the small intestine. **[3]**

(b) Draw a neat diagram of the female reproductive system and label any **THREE** parts. **[3]**

(c) After using a pesticide '*x*' to protect his crops for a long period of time, a farmer finds it no longer effective. Explain the ineffectiveness of the pesticide based on Darwinism. **[3]**

Question 6.

(a) Name the following: **[2]**

(i) The enzyme which helps in decarboxylation of pyruvate to acetyl-Co A in aerobic respiration.

(ii) The thick walled sclerenchymatous cells surrounding the vascular bundle in monocot stems.

(b) Describe the **THREE** components of an ATP molecule. **[3]**

(c) 'A rich biodiversity is highly beneficial to agricultural communities'. Support the statement by mentioning **FOUR** benefits. **[2]**

(d) Chose the appropriate characteristics given in the box for each type of cell and complete the table. **[3]**

single membrane envelope, nucleoid, double membrane envelope,

Monereans	**Protistean**

Question 7.

(a) (i) What is codon? **[1]**

(ii) 'The strong consensus at present is that the risk of germline manipulation in Gene therapy far exceeds any potential benefit and should not be attempted'. Do you agree? Justify the statement giving **TWO** reasons. **[2]**

(b) Explain briefly substitution mutation caused by transition and transversion with the help of an example. **[3]**

(c) In DNA sequencing, scientists have now developed a third generation sequencing which is much faster and less expensive. Give an example. **[1]**

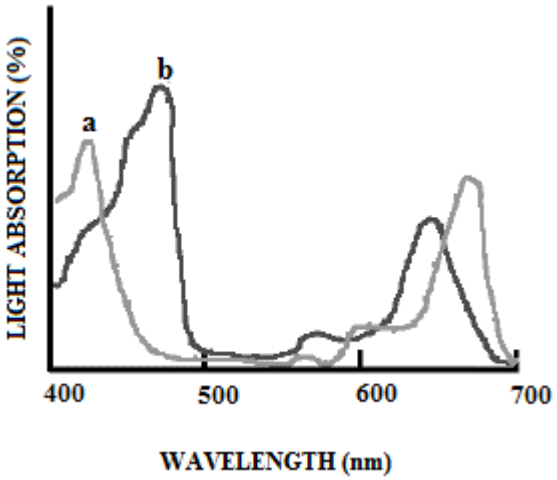
(d) 'The concentration of glomerular filtrate changes during its course through the Henle's loop'. Comment on the role of ascending and descending limb and concentration of their filtrate. **[3]**

Question 8.

(a) (i) Define ovulation. **[1]**

(ii) During a trek to Laya, Dorji felt dizzy after sometime. His friends gave him fruit juice instead of a solid meal. Why do you think so? **[2]**

(b) Study the graph given below and answer the questions that follow.



(i) What does the absorption spectrum of chlorophyll **a** and chlorophyll **b** indicate? **[1]**

(ii) Which chlorophyll produces higher photosynthetic yield? **[1]**

(iii) At what range of wavelength of light the rate of photosynthesis is the highest? **[1]**

(c) 'Cross pollination is preferred over self-pollination'. Do you agree? Justify with **TWO** reasons. **[2]**

(d) 'Conservation of biodiversity through 'National Parks' has brought a huge impact on local communities'. Do you agree? Justify. **[2]**