Federal Board HSSC-I Examination
Biology Model Question Paper
(Curriculum 2006)

SECTION – A

Time allowed: 25 minutes | Marks: 17

Note: Section-A is compulsory. All parts of this section are to be answered on the separately provided OMR Answer Sheet which should be completed in the first 25 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Choose the correct answer i.e. A / B / C / D by filling the relevant bubble for each question on the OMR Answer Sheet according to the instructions given there. Each part carries one mark.

1. Identify heteropolysaccharide from the following:
   A. Chitin
   B. Glycogen
   C. Pectin
   D. Cellulose

2. Glycolysis is a process that:
   A. Produces ATP and NADH
   B. Produces ATP only
   C. Is not a net producer of energy rich molecules
   D. Consumes as much ATPs as is produced

3. Carnivorous adaptations of plants mainly compensate for soil that has relatively low content of:
   A. Water
   B. Calcium
   C. Nitrogen
   D. Potassium

4. Wood consists mainly of:
   A. Bark
   B. Secondary xylem
   C. Cork
   D. Secondary phloem

5. What does the P wave represent in an ECG?
   A. Depolarization of the atria
   B. Depolarization of the ventricles
   C. Repolarization of the ventricles
   D. Depolarization of the atria and ventricles

6. Photorespiration is a problem for plant growth because it:
   A. Consumes excess CO_2 during the day
   B. Consumes excess CO_2 during the day and night
   C. Effectively undoes the work of photosynthesis by releasing CO_2
   D. Provides additional means of releasing energy from fuel molecules

7. In contrast to kingdom Animalia and Plantae, the organisms of kingdom Fungi have:
A. A cell wall
B. Centrioles in cells
C. Heterotrophic mode of nutrition
D. Nuclear mitosis

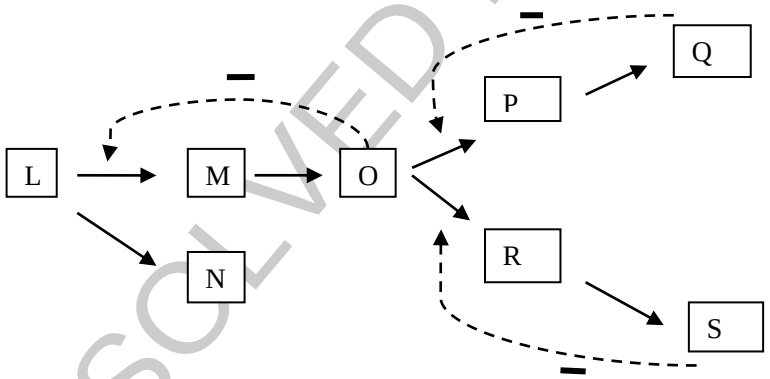
8. Which of the following is not common to all divisions of vascular plants?
A. Development of seeds
B. Alternation of generations
C. Xylem and phloem
D. Dominance of diploid generation

9. Which of the following subdivisions of the animal kingdom encompasses all the others in the list?
A. Protostomes
B. Deuterostomes
C. Bilateria
D. Coelomates

10. A certain poison disrupts the cytoskeleton of cell. Which of the following functions would be affected most probably by the poison?
A. Digestion within lysosomes
B. Protein synthesis
C. Cell division
D. Cellular respiration

11. Aslam wants to study the detailed function of glyoxysomes as cell organelles. Which of the following materials will be more suitable for his research?
A. Muscle cells
B. Mesophyll cells
C. Radish root cells
D. Oil seeds

12. In the following branched metabolic pathway, a dotted line with a minus sign symbolizes inhibition of a metabolic step by an end product:



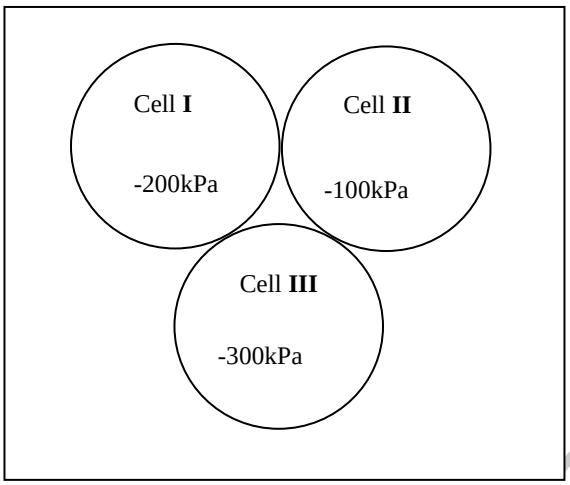
Which reaction would prevail if both Q and S are present in the cell in high concentration?
A. L → M
B. M → O
C. L → N
D. O → P

13. A microbiologist found that some bacteria infected by bacteriophages had developed the ability to make a particular amino acid that they couldn't make before. This new ability was probably a result of:
A. Conjugation
B. Transduction
C. Induction
D. Transformation

14. Only an animal species with diaphragm can be expected to have:
A. Lungs
B. Hair
C. Feathers
D. Moist skin

15. If a long day plant has a critical night length of 9 hours. Which of the following 24 hours cycles will prevent flowering?
A. 16 hours light/08 hours dark
B. 14 hours light/10 hours dark
C. 15.5 hours light/8.5 hours dark
D. 08 hours light/08 hours dark/flash of light/08 hours dark

16. The given diagram illustrates three adjacent cells with different water potential:



The direction of movement of water molecules across the given cells would be:
A. **I→II→ III**
B. **III→ II → I**
C. **II→ I→ III**
D. **III→ I → II**

17. After surgical removal of an infected gall bladder a person must be especially careful to restrict his/her intake of:
A. Starch
B. Sugar
C. Fats
D. Protein

SOLUTION

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
C	A	C	B	A	C	D	A	C
10	11	12	13	14	15	16	17	
C	D	C	B	B	B	C	C	

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Time allowed: 2.35 hours Total Marks: 68

SECTION – B (Marks 42)

Q.2 Attempt any **FOURTEEN** parts from the following. All parts carry equal marks. (14 × 3 = 42)

i. Define
a. Oligosaccharides b. Autophagy c. Virion

Answer: a. **Oligosaccharides:** Carbohydrates that on hydrolysis yield 2-10 monosaccharide units OrCarbohydrates produced by condensation of 2-10 monosaccharide units.

b. **Autophagy:** The self eating process of a cell in which unwanted structures within the cell are engulfed and digested by lysosomes.

c.**Virion:** A complete viral particle containing capsid and genome is called virion

ii. List the unifying Archaeal features that distinguish them from Bacteria.

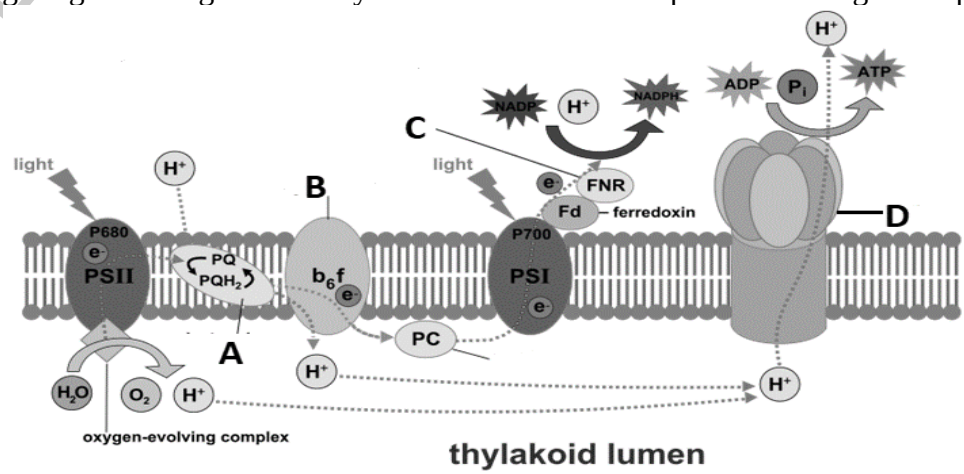
Answer: **Unifying features of Archaea:**

1. Composition of cell wall: Do not contain peptidoglycan. Composed of polysaccharides, protein or without cell wall
2. Composition of cell membrane: Contain unusual lipids in which glycerol is linked to branched chain hydrocarbon instead of fatty acids.
3. Methanogenesis
4. Mode of nutrition: Use three sources of energy i.e sunlight, inorganic compounds and organic compounds
5. Unique Ribosomal RNA sequence: AAACUUAAA

iii. Complete the following table.

Disease	**Causative agent**
Tuberculosis	*Mycobacterium tuberculosis*
Ringworm	*Microsporumaudouinii*/Fungi
Soft rot in potato	*Erwinaanylovora*/Bacteria
Athlete's foot	*Tinea pedis*/ Fungi
Late blight in potato	*Phytophthorainfestans*
Typhoid	*Salmonella typhi*

iv. In the following diagram a segment of thylakoid membrane is depicted showing an important metabolic process.



a. Name the parts labelled as A, B, C and D. (01)

Answer: A= Plastoquinone B= Cytochrome
C= Ferredoxin-NADP Reductase D= ATP Synthase

b. Explain the process that is depicted in the diagram. (02)

The process that is depicted is non-cyclic photophosphorylation and chemiosmosis. The photo excited P 680 of PS II when emit two electrons, it splits water to fill its electron hole, producing oxygen and H^+. The electrons pass through the electron transport chain, gradually releasing energy which is used to pump H^+ from stroma into the thylakoid lumen. The electrons after reaching PS I are again excited by light and enter into second electron transport chain, finally accepted by NADP along with H^+ of water producing NADPH. H^+ pass through ATP synthase and accompanied by synthesis of ATP (Chemiosmosis). As this ATP synthesis is driven by light, therefore it is called Photophosphorylation.

v. Make a list of the land adaptations of Bryophytes.

Answer:**Land adaptations of Bryophytes:**

1. Multicellular plant body and conservation of water
2. Absorption of CO_2
3. Absorption of water
4. Heterogamy
5. Protection of reproductive cells
6. Embryo formation
7. Alternation of generations

vi. Classify animals on the basis of body cavity.

Answer: Classification of animals based upon type of body cavity:

1. Acoelomates: No body cavity between digestive tract and outer body wall. The mesoderm is solidly packed between ectoderm and endoderm e.g Platyhelementhes.
2. Pseudocoelomates:A false cavity develops between mesoderm and endoderm e.g Aschelmenthes.
3. Coelomates: The body cavity forms within the mesoderm and is completely lined by mesoderm on both sides (True coelom). Cavity is filled with coelomic fluid e.g Annelida to Chordata

vii. Elaborate the role of Pancreas as an exocrine gland.

Answer: Pancreas as exocrine gland: The exocrine secretion of pancreas called pancreatic juice is transported through pancreatic duct into the duodenum, that contains an aqueous component and an enzymatic component. **Aqueous component** includes water and bicarbonates. Bicarbonte in the aqueous component neutralizes the acidic chyme. **Enzymatic component** contains:

- Inactive forms of proteolytic enzymes like Trypsinogen, Chymotrypsinogen and procarboxypeptidase which are changed into their active forms as Trypsin, Chymotrypsin and Carboxypeptiase by exposure to enterokinase or active trypsin. This activation takes place in lumen of small intestine.
- Pancreatic amylase continues the digestion of carbohydrates.
- Pancreatic lipase digest lipids into free fatty acids, glycerides and cholesterol.
- Deoxyribonucleases and ribonucleases reduce DNA and RNA into their nucleotides.

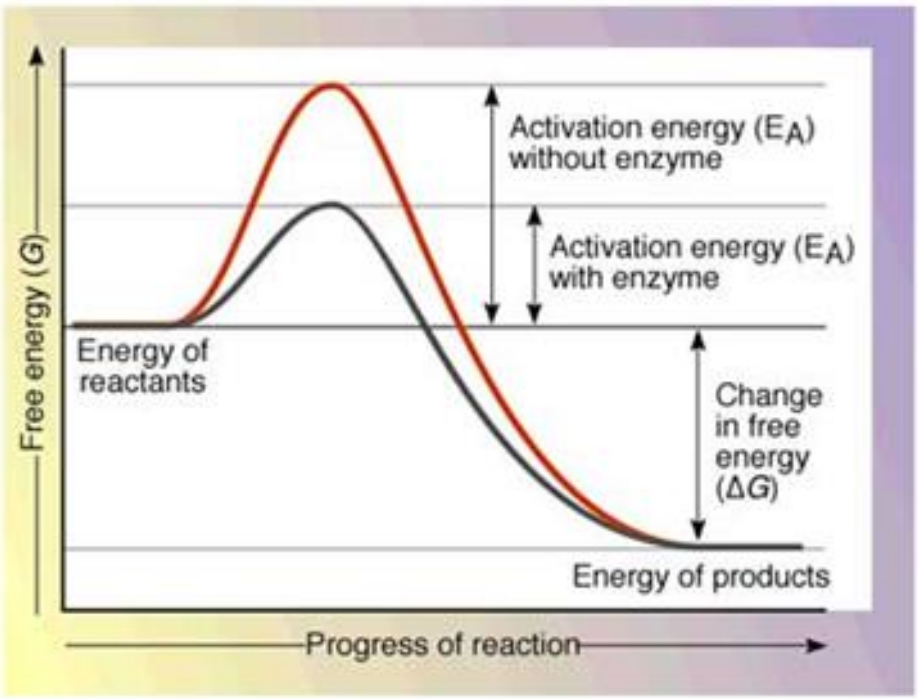
viii. List the ways, the fever kills microbes.

Answer: Fever or pyrexia is the raised body temperature than normal. The invaded microbes and certain white blood cells often produce pyrogens that raise the hypothalamic thermostat and body temperature.

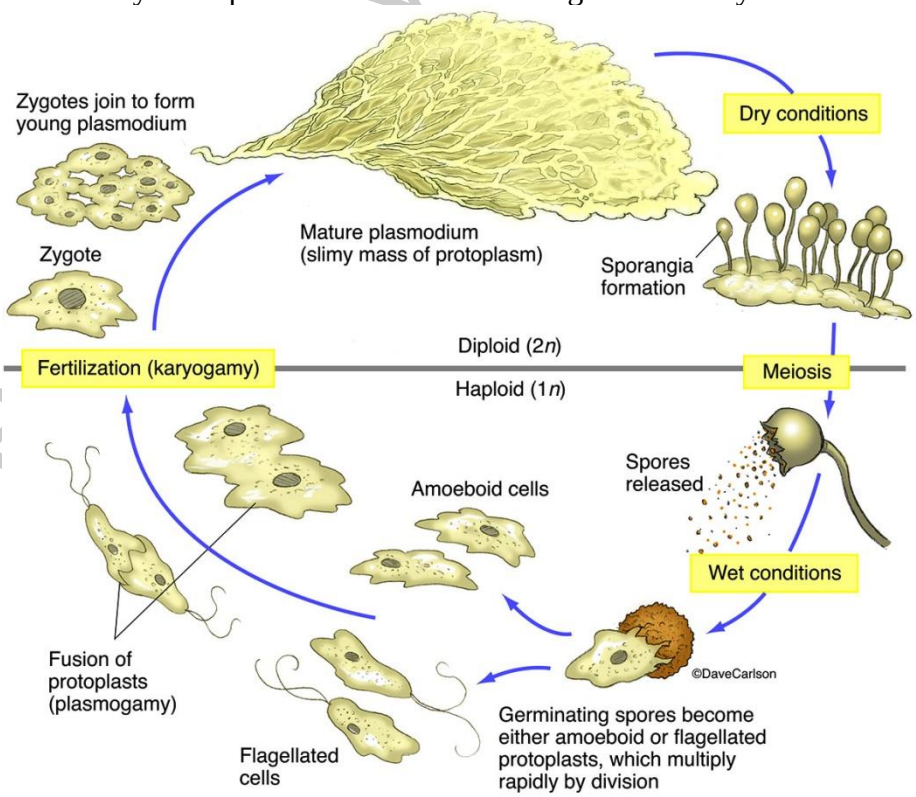
1. Higher than normal temperature increases the activity of phagocytic white blood cells that attack bacteria.

2. The endogenous pyrogens cause other cells to reduce concentration of iron in the blood because many bacteria need more iron to reproduce at temperature of 38°C or 39°C than 37°C. So fever and reduced iron concentration combine to slow down the growth of bacteria.
3. Fever also increases the production of interferons that travel to other cells to increase resistance to viral attack.
4. The higher body temperature may directly inactivate the virus particles, thus inhibiting their growth.

ix. Sketch a graph to show the effects of enzyme catalyzed and non-enzyme catalyzed reactions on activation energy.



x.Sketch the life cycle of plasmodial slime mold diagrammatically.



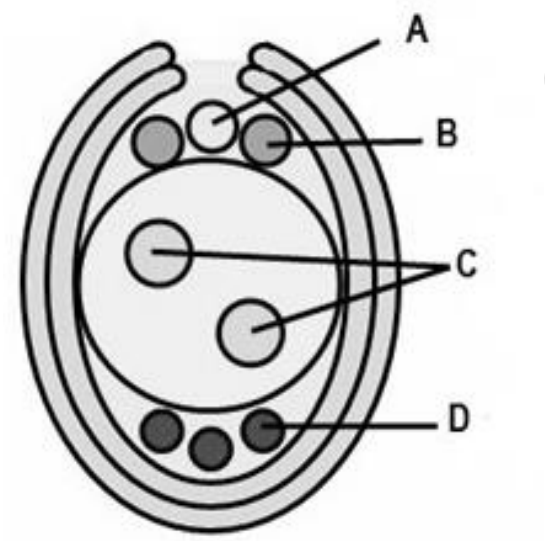
xi. How would you differentiate between Ascomycota and Basidiomycota? Show in a comparison table for at least six features.

Features	**Ascomycota**	**Basidiomycota**
Common name	Sac fungi	Club fungi
Fruiting body	Ascocarp	Basidiocarp
Structure of sporangium	Sac like Ascus	Club like Basisium
Asexual reproduction	Conidiospores (common)	Conidiospores (Rare), Fragmentation(Rare)
Spores produced after sexual reproduction	Ascospores	Basidiospores
Site of sexual spores	Inside the ascus	At the tip of basidium
Number of spores	Four or eight ascospores	Only four basidiospores
Examples	Yeasts, Morels, Truffles	Mushrooms,bracket fungi, rust, smut

xii. Give three features of Platyhelminthes for parasitic mode of life.
Answer:**Three adaptations for parasitic mode of life:** (Any three)

- Movement is restricted due to lack of locomotory structures.
- Digestive system is incomplete or absent
- No transport and respiratory system
- Possess suckers for attachment and food sucking
- Thick cuticle on body wall.
- Large number of off springs.

xiii. Following is the diagram of an ovule of flowering plants.



a. Correctly name the parts labelled as A, B, C and D. (0.5 x 4 = 02)
Answer: A= Ovum (Egg) B= Synergids C= Polar nuclei D= Antipodals

b. Which stage of the life cycle is represented by the 8 labeled cells? (01)
Answer: Megagametophyte (Female gametophyte)

xiv. Complete the following table for the comparison of Chondrichthyes and Osteichthyes.

Features	**Condrichthyes**	**Osteichthyes**
Position of mouth	Ventral	Terminal
Types of scales	Placoid	Dermal scales embedded in skine.gctenoid and cycloid
Endoskeleton made up	Cartilage	Partly or wholly bone

of		
Caudal fin	Heterocercal	Homocercal
Number of gill pairs	5-7 pairs	4 pairs
Operculum	Absent	Present

xv. Differentiate between Hydrophytes and Xerophytes in tabular form for at least six features.

Features	**Hydrophytes**	**Xerophytes**
Habitat	Aquatic	Terrestrial (Dry)
Availability of water	Abundant	Scarce
Problems faced by plants	Flooding	Severe dehydration
Rate of transpiration	Very high rate	Very low rate
Stomatal distribution	On upper epidermis	Sunken stomata
Stomatal opening	Stomata remain open all the time	Close in day and open at night
Thickness of cuticle	Very thin or none	Very thick
Storage of water	None	Store water in succulent organs

xvi. A particular small polypeptide is nine amino acids long. Using three different enzymes to hydrolyze the polypeptide at various sites, we obtained the following five fragments (N denotes the amino terminal of the polypeptide).

- Alanine-Leucine-Aspartic acid-Tyrosine-Valine-Leucine
- Tyrosine-Valine-Leucine
- N-Glycine-Proline-Leucine
- Aspartic acid-Tyrosine-Valine-Leucine
- N-Glycine-Proline-Leucine- Alanine-Leucine

a. Determine the primary structure of this polypeptide. (02)

Answer: a. N-Glycine-Proline-Leucine-Alanine-Leucine-Aspartic acid- Tyrosine-Valine-Leucine

(Guidance Note: Protein sequencing of a peptide can be done by finding the overlapping sequences and arranging them in a way that completes the length of peptide. N terminal shows the position of first amino acid. In this case first and last fragments are used to determine the primary structure in following way.

N-Glycine-Proline-Leucine- Alanine-Leucine

Alanine-Leucine-Aspartic Acid-Tyrosine-Valine-Leucine

1 2 3 4 5 6 7 8 9

It's like solving a puzzle using logical reasoning)

b. Highlight the significance of amino acid sequence in proteins. (01)

Answer: Amino acid sequence is responsible for primary structure of protein. Any change in amino acid sequence will lead to change in secondary and tertiary structure that may disrupt the proper structure and the protein will not be able to perform its function.

xvii. Apply your knowledge of fungi to signify their role in genetic research.

Answer: **Role of Fungi in genetic research:**

- Researchers use *Saccharomyces* (Yeast) to study the molecular genetics of eukaryotes, because its cells are easy to culture and manipulate.
- Pink mold (*Neurospora*) has been used for genetic research
- Yeast was the first eukaryote to be used in genetic engineering.
- Functional artificial chromosome was made in *Saccharomyces cerevisiae*.
- *Saccharomyces cerevisiae* was the first eukaryote whose genetic sequence was completely studied. (Note; Any three)

xviii. A tip for making cut flowers last longer without wilting is to cut off the ends of stems under water and then transfer the flowers to a vase full of water while drops of water are still present on the cut ends of the stem. Explain why this works?

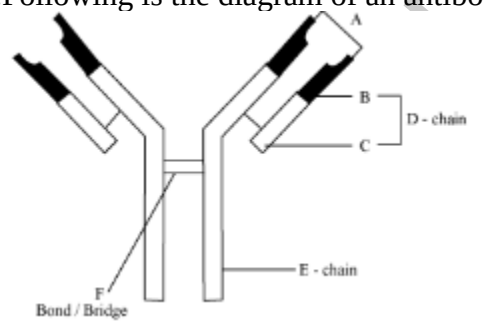
Answer: For the upward movement of water through plants, the most acceptable theory is the TACT theory. Four factors i.e., Transpiration pull, Adhesion, Cohesion and Tension are combined to form a force that is responsible for ascent of sap. Cut flowers remain fresh for longer when cut this way is following the principle of TACT mechanism. Cutting underwater minimize air bubble entry in xylem. These air bubbles disrupt TACT by breaking water column which forms due to Cohesion.

xix. Advise some changes in life style that could protect people from hypertension and cardiac problems.

Answer: **Changes in life style to prevent hypertension and cardiac problems:**

1. Avoid smoking, as cigarette smoke contains nicotine that causes arterioles to constrict and raise blood pressure.
2. Avoid stimulants like cocaine and amphetamines as they can cause irregular heart attack and stroke.
3. Avoid drinking alcohol as it is one of the leading causes of CVD.
4. Try to maintain normal body weight.
5. Take diet having low cholesterol, low saturated fats and low salt.
6. ForVitamins,calcium, magnesium and potassium, take grains, fruits and green vegetables.
7. Regular exercise. At least 30 minutes' walk daily.
8. Drink 6-8 glasses of water daily.
9. Avoid stress and anxiety. Learn to de stress.
10. Sound sleep of 7-8 hours.

xx.Following is the diagram of an antibody:



a. Correctly name the parts labelled as A, B, C, D, E and F. (0.25 x 6 = 1.5)

Answer: A= Antigen binding site B= Variable segment C= Constant segment
D= Light chain E= Heavy chain F= Disulphide bridge

b. Which type of human cells produces these antibodies? (0.5)

B Lymphocytes (Plasma cells)

c. List the four different modes of action of antibodies. (0.25 x 4 = 01)

1. Neutralizing antigen 2. Activating complement
3. Precipitating antigen 4. Facilitating phagocytosis

SECTION – C(Marks 26)

Note: Attempt any **TWO** questions. All questions carry equal marks. (2×13 = 26)

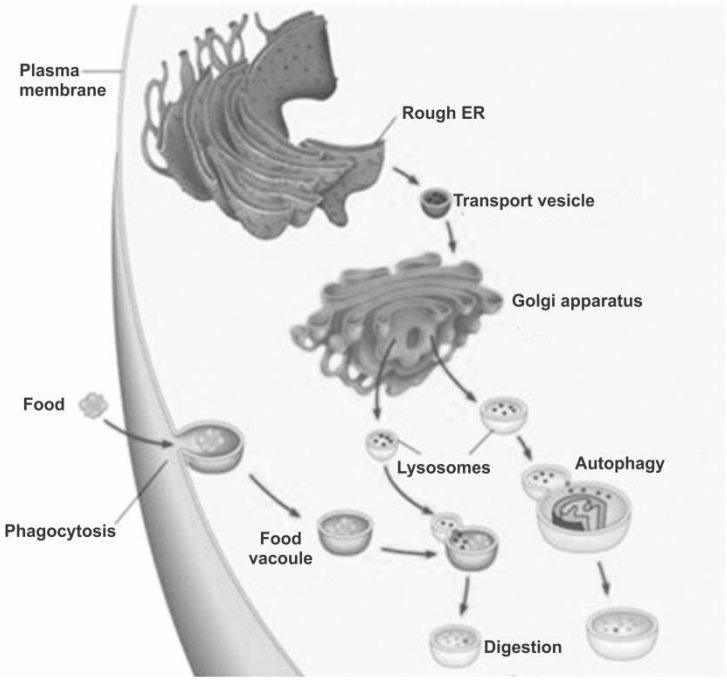
Q.3. a. Explain the formation, structure, functional role and disorders related to Lysosomes. **(1.5 x 4 = 6)**

Answer: Lysosomes:

Structure:*Lyso* means splitting and *soma* means body. These are single membranous, spherical vesicles. They contain digestive or hydrolytic enzymes.

Formation: The lysosomal enzymes are made by the RER and then are transported to Golgi complex through SER. After modification, these enzymes are released from the *trans* face of Golgi complex in the form of vesicles. Such vesicles are called lysosomes. The newly formed lysosomes before the start of their functions are usually called **primary lysosomes**. In plants and fungi, certain vacuoles carryout enzymatic hydrolysis, a function shared by lysosomes in animal cells.

Functions: Lysosomes contain about 40 different digestive enzymes. These enzymes can breakdown every major macromolecule of the cell. The contents of the **lysosome** are acidic. In order to perform its function, the lysosomes fuse with membrane bound vesicle that arises from any of these pathways **endocytosis, phagocytosis** or **autophagocytosis.** These vesicles are referred to as endosomes, phagosomes and autophagosomes respectively. These endosome fuses with lysosomes (primary lysosomes) and forms **secondary lysosomes**. The bio-molecules are further broken down into smaller forms like amino acids, monosaccharides, nucleotides and fatty acids which are then recycled in the cell. Major functions of lysosomes include **intracellular digestion**, **autophagy**, **autolysis** and sometimes **release of extra cellular enzymes**.

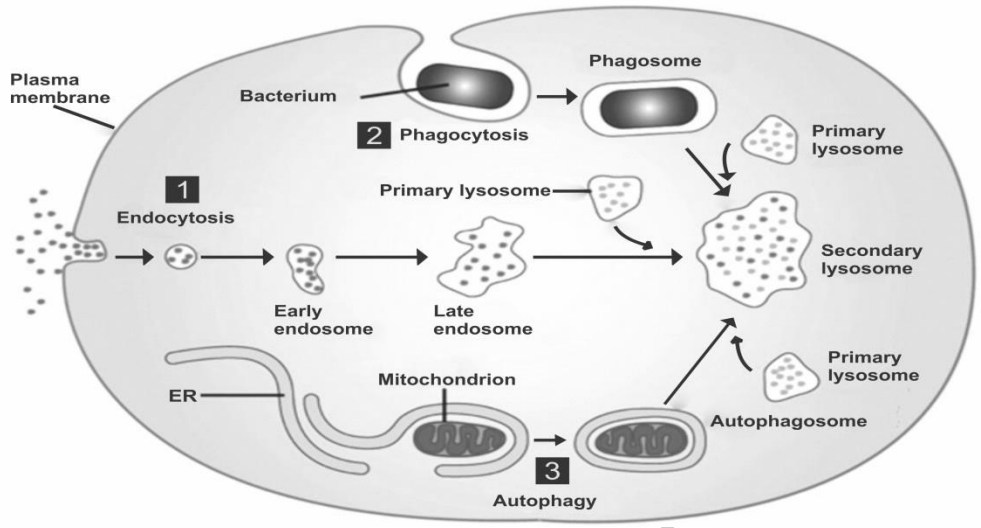


Formation and functions of Lysosomes

The ingested food of cell is stored in vesicles, called **food vacuoles**. Once a lysosome has fused with food vacuole, the resulting structure is called **secondarylysosome** in which food begins to digest. The digested products are absorbed by the cytoplasm while the remaining wastes containing vesicle is now called **contractile vacuole**. Later on these vacuoles fuse with cell membrane (exocytosis) to eliminate undigested wastes. This whole process is known as **intracellular digestion**.

The process by which unwanted structures within the cell are engulfed and digested within the lysosomes is called **autophagy**. This is self-eating process of a cell in which a lysosome begins to digest cell's own organelles. Such lysosomes are also called **autophagosomes**. This process either takes place in starvation period in order to obtain energy or it occurs in routine in order to control number of specific organelle. For example: If someone starts to perform heavy muscular exercise, the number of mitochondria begins to increase in his muscle cells, but if he leaves exercise, the number of mitochondria are again decreased by the process of autophagy.

Sometimes, especially during developmental phase,when a particular cell is required to be disintegrated, a type of cell death is committed, called **autolysis.** This is aprogrammed cell death in which lysosomes burst and their enzyme contents are quickly dispersed throughout the cytoplasm. In this way the cell is disintegrated into fragments which are phagocytosed by other cells. Due to these function lysosomes are also called **suicidalbags**.

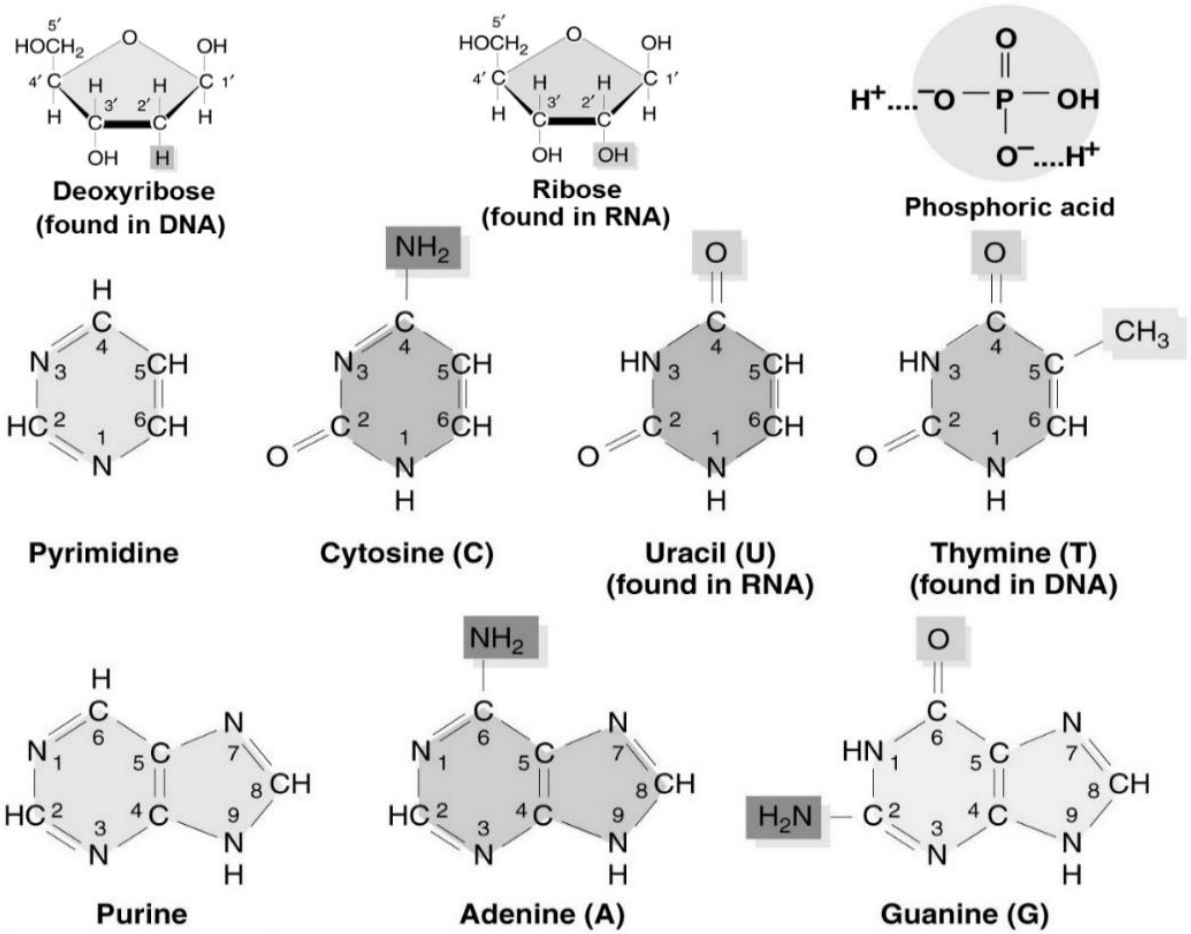


Functions of Lysosomes

Disorders: Since,lysosomes contain various digestive enzymes, if a particular lysosomal enzyme is missing in an individual, thedigestion of that particular substance (for which enzyme was specific) will be affected. As a result, the substance begins to accumulate in the cell and cause different problems. Such complications which are caused by the accumulation of various substances in the cell due to lack of certain lysosomal enzymes are called **lysosomalstoragediseases**. These diseases are hereditary and congenital therefore run in particular families and exist by birth in an individual. Most of these diseases are fatal in early childhood. About more than 20 such diseases have been discovered so far. One of the common examples is **Tay-Sachs disease** in which a lipid digesting enzyme is missing or inactive and the brain becomes impaired by an accumulation of lipids in the cell.

b. Describe the chemical composition of nucleotides showing the structural formulae of all components. **(7)**

Answer: Composition of a nucleotides: Nucleotides of DNA are called **deoxyribonucleotides** and of RNA are known as **ribonucleotides**. Each nucleotide consists of pentose sugar, a phosphate and a nitrogen containing ring structure called base. The **pentose sugar** in

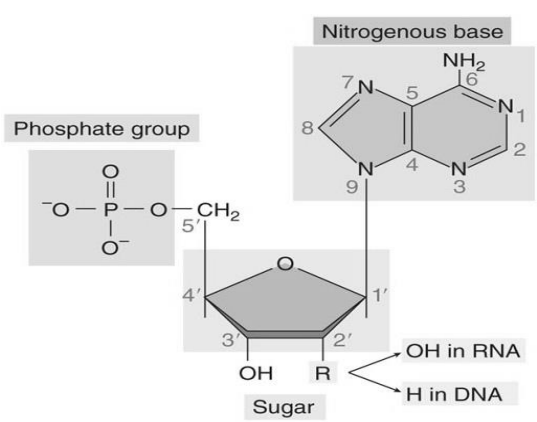


Components of nucleotides

deoxyribonucleotides is deoxyribose and in ribonucleotides is ribose. **Phosphoric acid** is a common component of both nucleotides which provides acidic properties to DNA and RNA. The nitrogen containing ring structures are called **bases** because of unshared pair of electron on nitrogen atoms, which can thus acquire a proton.

There are two major classes of nitrogenous bases i.e., single ring **pyrimidine** and double ring **purines**. Pyrimidine bases are of three types i.e., cytosine (C), thymine (T) and uracil (U). Thymine is only found in DNA while the uracil is only found in RNA. On the other hand, the purine bases are also of two types i.e., adenine (A) and guanine (G).

During the formation of a nucleotide, first nitrogenous base is linked with 1′ carbon of pentose sugar. Such combination is called **nucleoside**. When a phosphoric acid is linked with 5′ carbon of pentose sugar of a nucleoside, the nucleotide is formed. A nucleotide with one phosphoric acid is called **nucleoside monophosphate** with two phosphoric acids is called **nucleoside diphosphate** and with three phosphoric acids is called **nucleoside triphosphate.**



Structure of a nucleotide

Q.4. a. How CO_2 is converted into glucose during light independent reactions of photosynthesis? **(6)**

Answer: **Light Independent Phase (Dark Reaction):**

The light independent phase (dark reaction) takes its name from the fact that light is not directly required for these reactions to occur. This phase requires the availability of NADPH, ATP (the products of light reaction) and CO_2. In this phase of photosynthesis, NADPH is used to reduce carbon dioxide while ATP is used to incorporate energy. Finally, CO_2 is converted into a phosphorylated triose carbohydrate i.e., glyceraldehyde-3-phosphate (G3P) which are later on used to make glucose. Dark reaction generally involves a complicated metabolic pathway, the Calvin cycle or C3 pathway. However, in some plants, in addition to Calvin cycle another metabolic pathway is also involved, called **C4 pathway.** The plants in which only Calvin cycle occurs during dark reaction are called **C3 plants**.

Calvin cycle: Calvin cycle term is applied to the series of metabolic reactions in which CO_2 is reduced to produce G3P.These reactions have been explored by **Melvin Calvin** and co-workers. The Calvin cycle can be divided into three phases, carbon fixation, reduction and regeneration of carbon dioxide acceptor i.e., RuBP.

Carbon fixation:

One of the key substance in this process is a five carbon phosphorylated sugar called **ribulose bisphosphate (RuBP)**. It is generally referred as **CO_2 acceptor** because it is capable of combining with carbon dioxide with the help of Ribulose bisphosphate (RuBP) carboxylase/oxygenase also known as **RuBisCO**. Three intermediate molecules of six carbons are formed during this reaction. These molecules are unstable and exist for such a short time that, they cannot be isolated. Each six carbon breaks down to form two molecules of 3-phosphoglycerate (3-PGA), a phosphorous containing compound with three carbon atoms. Since, the carbon of inorganic compound (CO_2) becomes the part of organic compound (RuBP) during this phase, hence, it is called **carbon fixation**. As the first stable compound in the Calvin cycle is a three carbon compound(3-PGA) that is why Calvin cycle is also known as **C3 pathway**.

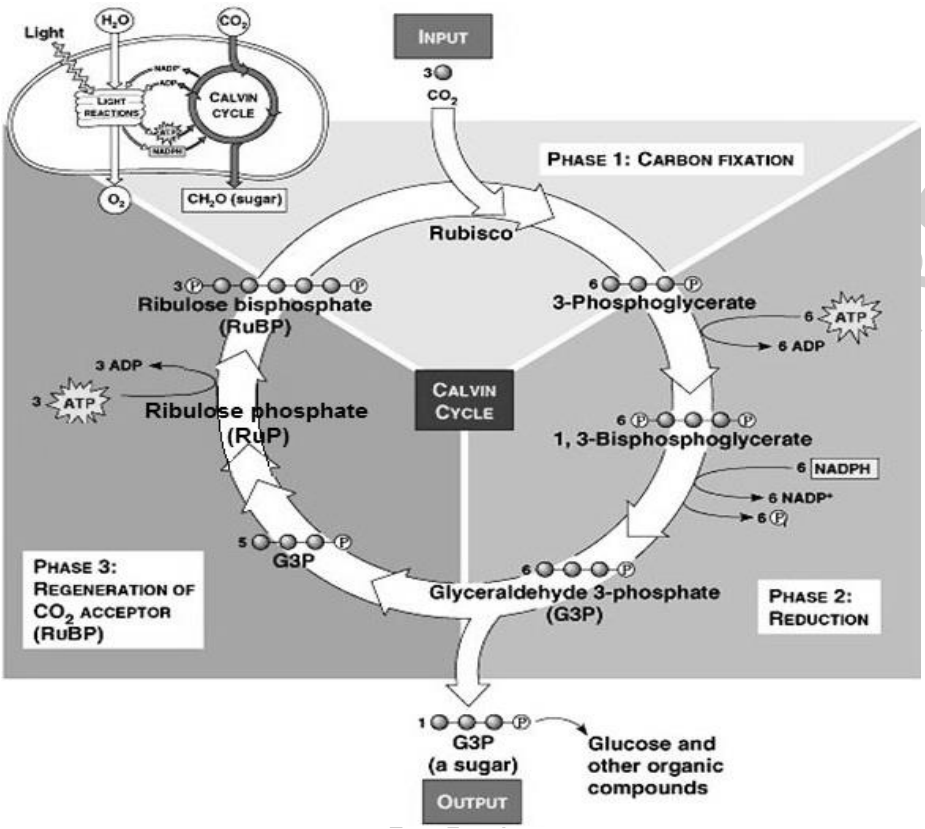
Reduction

In this phase six molecules of 3-phosphoglycerate (3-PGA) react with six ATP molecules, a phosphate from each ATP is transferred to each 3-PGA. In this way, 3-PGA molecules are changed into 1,3-Bisphosphoglycerate. These molecules are then reduced by the hydrogen of NADPH and finally glyceraldehyde 3 phosphate (G3P) molecules are produced. During this reduction process a phosphate group from each 1,3-Bisphosphoglycerate molecule is also given off. There are total six molecules of G3P are produced in this phase but only one molecule is released from the cycle while rest of the five molecules are used to regenerate the CO_2 acceptor molecules in the next phase.

Regeneration of CO_2 acceptor

Five molecules of G3P from the previous phase are used to regenerate the RuBP (CO_2 acceptor) in this phase. These five molecules each containing three carbon atoms undergo a series of reactions in which three molecules of ribulose phosphate (RuP) each containing five carbon atoms are produced. When three molecules of RuP react with three molecules of ATP, a phosphate group from each ATP is transferred to each RuP. Ultimately RuP are converted into RuBP which again participate in the next cycle.

The whole process of Calvin cycle indicates that there are three molecules of CO_2, six molecules of NADPH (reducing power) and nine molecules of ATP (assimilating power) are used to release just one molecule of G3P form the cycle. However, in order to produce a



Calvin cycle

glucose molecule, two molecules of G3P are required.

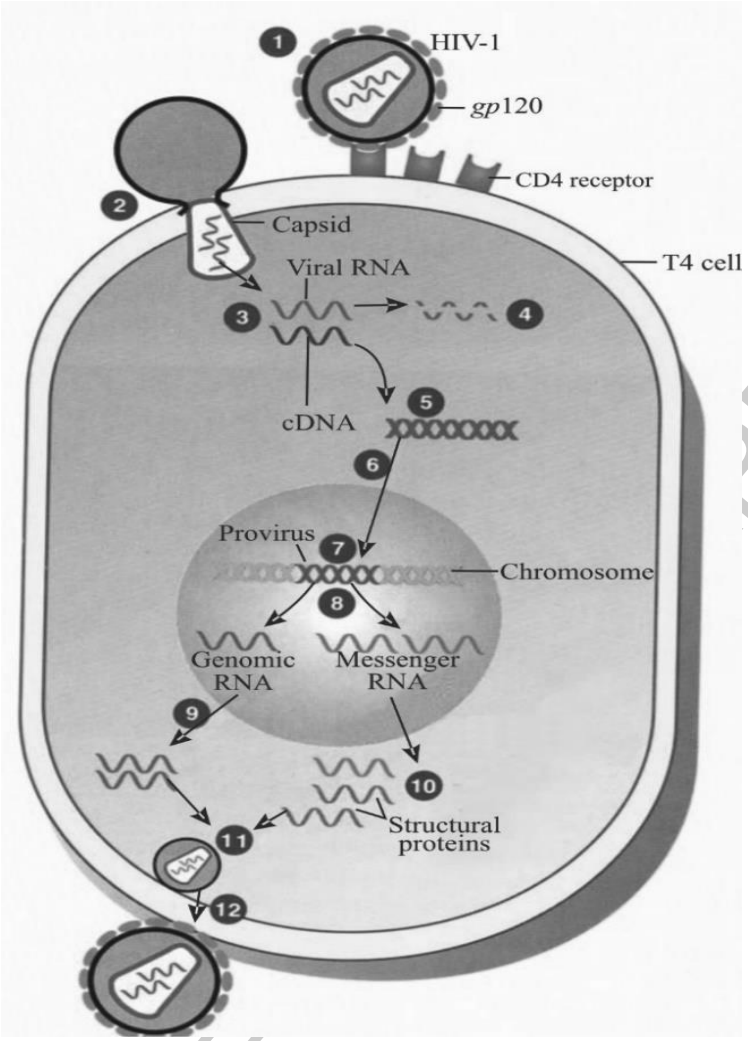
b. Elaborate the life cycle of HIV in human body. (7)

Answer: Life Cycle of HIV:

The primary hosts of HIV are helper T lymphocytes (CD4 or T4 cells). In addition, macrophages and certain brain cells may also be affected. Following steps are involved in the life cycle of HIV. (1) The initial step in the life cycle of HIV is adsorption/attachment which is characterized by the binding of the virion glycoprotein 120 envelope proteins to the CD4 proteins (a receptor) on the surface of T4 cells. (2) Next the fusion of the viral envelope with the cell membrane takes place and the virion enters the cell by endocytosis. Once inside the host cell, the HIV particle sheds its protective coat i.e., **uncoating** occurs. This leaves the single stranded viral RNA in the cytoplasm along with viral enzymes. (3) The enzyme called **reversetranscriptase** synthesizes a single stranded DNA complementary to virus RNA therefore, called **complementary DNA** (cDNA). (4) After reverse transcription the viral genomic RNA is disintegrated by the ribonuclease (RNAase) enzyme. (5) The single stranded cDNA is replicated to form double stranded cDNA. (6) The double stranded cDNA then integrates into the host cell DNA. Integration is mediated by a virus encoded enzyme integrase**.** (7) The integrated DNA is now called **provirus**. (8 and 9) Viral mRNA is transcribed from the proviral DNA by the host cell RNA polymerase. During **transcription** not only viral mRNAs for different protein are formed but viral genomic RNA is also produced. (10) The viral mRNAs are **translated** by host ribosomes into several large proteins, which are then cleaved by the virus-encoded protease to form the virion structural proteins. (11) The viral components are assembled and **maturevirions** are produced. (12) Finally, the mature virions are gradually **released by budding off** from the host cell and enclosing a portion of host cell membrane around them. In this way host cell size is decreased enough that it becomes non-functional.

Since, helper T cells regulate immunity by enhancing the response of other immune cells so, the decrease in the number of helper T cells causes deficiency of the human immune system. The

virus affects the human immune system, therefore, the virus has been named Human Immunodeficiency Virus (HIV).



Life cycle of HIV 1. Attachment 2. Penetration. 3. Reverse transcription. 4. Breakdown of viral genomic RNA. 5. Replication. 6. Integration. 7. Provirus. 8. and 9. Transcription. 10. Biosynthesis of protein. 11. Maturation. 12. Release.

Q.5. a. How translocation of organic solutes takes place through phloem in plants? (4)

a. **Translocation of organic solutes:**

The movement of prepared food (organic solutes) to different parts of the plant body through phloem tissue is called translocation of organic solutes.

Pattern or direction of translocation

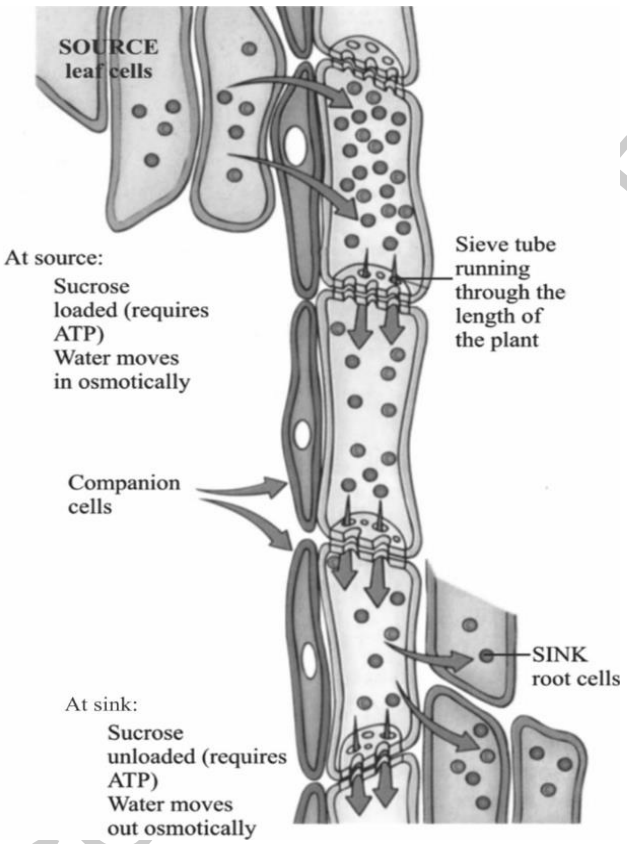
Like ascent of sap, this movement cannot be characterized as upward or downward movements, because prepared food is to move to different directions. Therefore, in order to define the direction of this movement it is usually said that translocation always occurs from a **source** towards a **sink**. The term source is applied to the area of supply of food such as food manufacturing organ or storage organ (when it supplies the food). The term sink is used for the area of utilization of food such as metabolizing organ or storage organ (when it stores the food). Leaf is purely a source while fruit is particularly a sink on the other hand root and stem act as both source, and sink.

Composition of translocating fluid (Phloem sap)

The studies of composition of phloem sap have revealed that it consists of 10-25% dry matter. The 90% of this dry matter is sucrose (cane sugar), while remaining are other organic compounds.

Mechanism of translocation

The most acceptable theory that explains the mechanism of translocation of organic solutes is the **pressure flow** or **mass flow theory**. According to this theory, the sugars produced in **sourceregions**, such as photosynthesizing leaves or storage places are loaded into the phloem's sieve tube elements by the companion cells. The activetransport increases the concentrations of sugars in the phloem, thus water potential is decreased. As a result, water moves to phloem by osmosis from the nearby xylem cells and increases hydrostatic pressure in the phloem cells, which pushes forcibly the sugary solution away from the leaf (**source**). The pressure gradient from source to sink causes translocation from the area of higher hydrostatic pressure (the source) to the area of lower hydrostatic pressure (the sink). When this solution is reached to the sink such as roots, the root cells actively absorb the organic solutes from this solution. The loss of solutes in phloem sap causes an increase in water potential so the water from the phloem flows back to the xylem tubes.



Pressure flow Mechanism for Phloem Transport:

b. Discuss the role of stomach in the process of digestion. (4)

Answer: **Functions of stomach:**

Digestion in the stomach can be divided into two types: mechanical digestion and chemical digestion.

Mechanical digestion: The mixing action of the stomach walls allows mechanical digestion to occur in the stomach. The smooth muscles of the stomach produce contractions known as **mixing waves**. This is made more efficient by the fact that unlike other region of the alimentary canal the stomach has three layers of smooth muscles. The churning action of the stomach or mixing waves mix the boluses of food with gastric juice. This mixing leads to the production of the thick liquid known as **chyme**.

Chemical digestion: Stomach secretions include mucus, hydrochloric acid, gastrin, intrinsic factor and pepsinogen. The mucous cells secrete viscous and alkaline **mucus**. The thick layer of mucous lubricates and protects the epithelial cells of the stomach wall from the damaging effect of the acidic chyme and pepsin. **Parietal cells** in the gastric glands of the pyloric region secrete intrinsic factor and a concentrated solution of hydrochloric acid. **Intrinsic factor** is a glycoprotein that binds with vitamin B12 and makes the vitamin more readily absorbed in the ileum. **Hydrochloric acid** produces the low pH of the stomach, which is normally between 1 and 3, but is usually close to 2. Although the hydrochloric acid secreted into the stomach has a minor digestive effect on digested food, one of its main functions is to kill bacteria that are ingested

with essentially everything humans put into their mouths. The low pH of the stomach also stops carbohydrate digestion by inactivating salivary amylase. The low pH also denatures many proteins so that proteolytic enzymes can reach internal peptide bonds, and it provides the proper pH environment for the function of pepsin.

Chief cells within the gastric glands secrete inactive pepsinogen. Pepsinogen is packaged in zymogen granules, which are released by exocytosis when pepsinogen secretion is stimulated. Once pepsinogen enters the lumen of the stomach, it is converted to pepsin by hydrochloric acid and previously formed pepsin molecules. Pepsin exhibits optimum enzymatic activity at a pH of 3 or less. Pepsin catalyzes the cleavage of some covalent bonds in proteins, breaking them into smaller peptide chains.

c. Elaborate the sequence of events that occur during cardiac cycle of humans. (5)

Answer: Heartbeat and its Control:

In a continuous, rhythmic cycle heart is passively filled with blood from the large veins and then the heart actively contracts, propelling the blood throughout the body. Its alternating relaxations and contractions make up the **cardiac cycle**. The cardiac cycle is a sequence of one heartbeat.

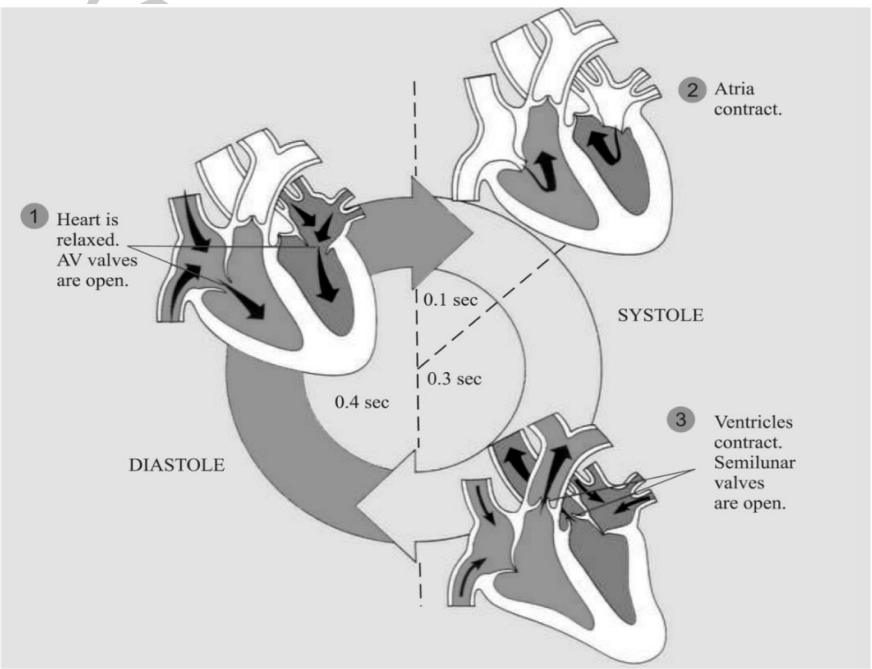
Phases of heartbeat

The term systole means to contract and diastole means to dilate. **Atrial systole** is contraction of the atrial myocardium and **atrial diastole** is relaxation of the atrial myocardium. Similarly**ventricular systole** is contraction of the ventricular myocardium and **ventricular diastole** is the relaxation of the ventricular myocardium. When the word "systole" and "diastole" are used without reference to specific chambers, they mean ventricular systole or diastole.

In **atrial diastole** blood enters the right atrium from the body through the vena cavae. At first the bicuspid and tricuspid valves are closed, but as the atria fill with blood, pressure in them rises. Eventually it becomes greater than that in the relaxed ventricles and the valves are pushed opens. In **atrial systole** the two atria contract simultaneously and blood is pushed through the **atrio-ventricular** valve into the still relaxed ventricles. At this phase semilunar valve is closed, tricuspid and bicuspid valves are open.

In **ventricular systole** almost immediately the **ventricles** contract. When this occurs the pressure in the ventricles rises and closes the atrioventricular valves, preventing blood from returning to the atria. This pressure forces, open semilunar valves of the aorta and the pulmonary artery and blood enters these vessels. In this phase the tricuspid and bicuspid valves are closed.

In **ventricular diastole** the high pressure developed in the aorta and pulmonary artery tends to force some blood back towards the **ventricles** and close the **semilunar valves** of the aorta and pulmonary artery. Hence back flow in the heart is prevented. In this phase **bicuspid valve** and **tricuspid valve** are open, **aortic semilunar valve**, and **pulmonary semilunar valve** are closed. The normal cardiac cycle is of 0.7 to 0.8 second depending on the capability of cardiac muscle to contract. The heart muscle rests 0.1 to 0.3 second between the beats.



Cardiac cycle