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BOTANY

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1. Transport in Plants**VERY SHORT ANSWER QUESTIONS**

1. What are porins? What role do they play in diffusion?

A. Porins are proteins that form huge pores in outer membrane of Plastids, Mitochondria and some Bacteria.

* They allow molecules up to the size of small proteins to pass through.

2. Define water potential. What is the value of water potential of pure water?

A. The difference between the free energy of water molecules in pure water and solution is called water potential (ψ_w).

* Water potential of pure water is zero.

3. Differentiate osmosis from diffusion.

A. The movement of solvent from a region of lower concentrated solution to a region of higher concentrated solution through semi-permeable membrane is called osmosis.

* The movement of ions or molecules or atoms from a region of their higher concentration to the region of their lower concentration without having any membrane is called diffusion.

4. What are apoplast and symplast?

A. The apoplast is the non living system of plant. It is connected with adjacent cell walls and intercellular spaces.

* The symplast is the living system of plant. It is connected with protoplasts.

5. How does guttation differ from transpiration?

A. The loss of water in the form of liquid through hydathodes is known as guttation.

* The loss of water in the form of vapour from aerial parts of plants through stomata is called transpiration.

6. What are the physical properties of water responsible for the ascent of sap through xylem in plants?

A. Cohesion, Adhesion & Transpiration pull.

7. With reference to transportation of food within a plant, what are source and sink?

A. Source : the part of the plant which synthesizes the food. Eg: Leaf.

* Sink : the part of the plant that needs or stores the food. Eg: Root, Fruit.

8. Does transpiration occur at night? Give an example.

A. Yes.

* Succulent xerophytes. Eg: *Bryophyllum*.

9. Compare the pH of guard cells during the opening and closing of stomata.

A. During opening of stomata, high pH in guard cells.

* During closing of stomata, low pH in guard cells.

10. In the wake of transpiration loss, why do the C₄ plants are more efficient than C₃ plants?

A. The evolution of the C₄ photosynthetic system is probably one of the strategies for minimizing water loss.

* C₄ plant loses only half as much water as a C₃ plant for the same amount of CO₂ fixed.

11. What is meant by transport saturation? How does it influence facilitated diffusion?

A. When all of the protein transporters are being used, it is called transport saturation.

* Transport rate reaches a maximum when all of the protein transporters are being used in facilitated diffusion.

12. How does ABA bring about the closure of stomata under water stress conditions?

A. Under water stress conditions, abscisic acid drives the K⁺ ions out of guard cells making them close.

13. Compare imbibing capacities of Pea and Wheat seeds.

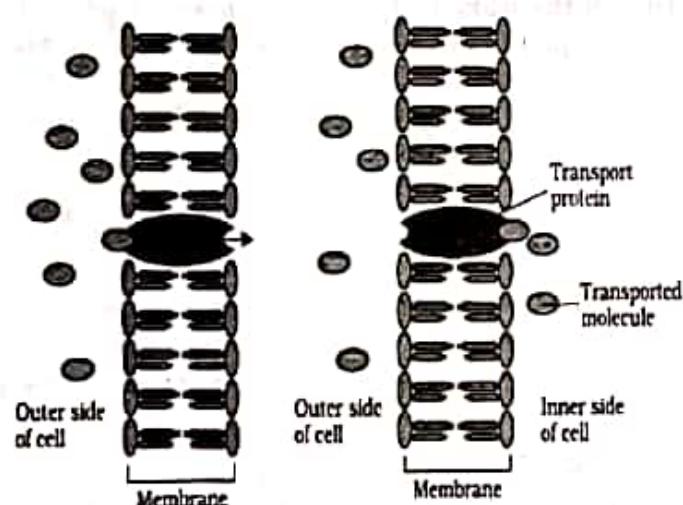
A. Proteinaceous Pea seeds swell more on imbibing water than starchy Wheat seeds.

SHORT ANSWER QUESTIONS

- Define and explain water potential.
- Water potential is defined as the chemical potential (free energy) of water.
- * Water potential is denoted by the Greek symbol Psi or Ψ .
- * It is expressed in pressure units such as pascals (Pa).
- * The water potential of pure water at standard temperatures, and pressure is taken to be zero.
- * Water will move from the region with higher water potential to the region with low water potential.
- * Solute potential (Ψ_s) and Pressure potential (Ψ_p) are the two main components that determine water potential.
- * $\Psi_w = \Psi_s + \Psi_p$

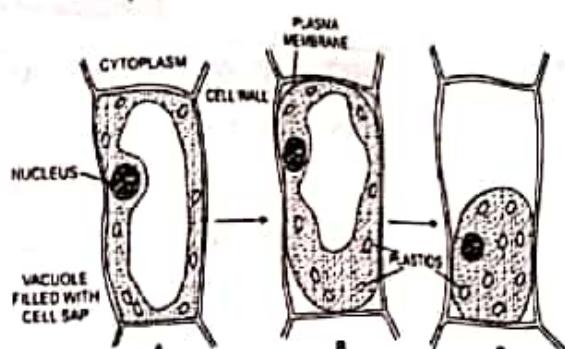
2. Write short notes on facilitated diffusion.

A.



- * In facilitated diffusion, special proteins help move substances from high concentration region to low concentration region across membrane without expenditure of ATP energy.
- * Special proteins are channels, porins etc.
- * Transport rate reaches a maximum when all of the protein transporters are being used.
- * Facilitated diffusion is very specific.
- * It is sensitive to inhibitors.

- What is meant by plasmolysis? How is it practically useful to us?



Various stages in plasmolysis : B. Incipient plasmolysis ; C. a plasmolysed cell.

- * The phenomenon of shrinkage of protoplast due to osmotic diffusion of water from the cells into surrounding environment is called plasmolysis.
- * This occurs when the cell (or tissue) is placed in a hypertonic solution.
- * Water moves out; it is first lost from the cytoplasm and then from the vacuole.
- * The salting of Pickles and preserving of Fish and Meat in salt are good examples of practical applications of plasmolysis.
- 4. How does ascent of sap occur in tall trees?
- A. The cohesion-tension-transpiration pull model explains the ascent of sap in tall trees.
- * It was proposed by Dixon.
- * Ascent of sap depends mainly on the following physical properties of water.
- * Cohesion, Adhesion Forces.
- * These properties give water high tensile strength and high capillarity.
- * In plants, capillarity is aided by the small diameter of the tracheiary elements – the tracheids and vessels.
- * Transpiration pull is the driving force for upward movement of water.
- * Measurements reveal that the forces generated by transpiration can create pressures sufficient to lift a xylem sized column of water over 130 meters high.

5. Explain pressure flow hypothesis of translocation of sugars in plants.

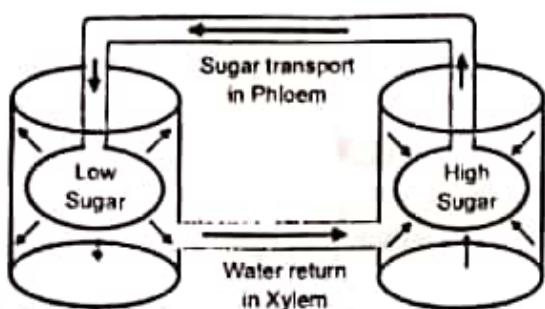


Diagram of Munch mass flow in phloem

- * The pressure flow hypothesis explains translocation of sugars.
- * It was proposed by Munch.
- * Glucose is prepared at the source is converted to sucrose.
- * The sucrose moved into the companion cells and then into the sieve tube by active transport. it leads to decrease in water potential in sieve tubes
- * Water in the adjacent xylem moves into the phloem by osmosis.
- * As osmotic pressure builds up, the phloem sap moves to areas of lower pressure(sink).
- * At the sink, incoming sugars are actively transported out of the phloem.
- * Water potential increases in the phloem.
- * Water moves out of the phloem by osmosis.

6. "Transpiration is a necessary evil". Explain.

A. Advantages of Transpiration :

- * It supplies water for photosynthesis.
- * It helps in transports minerals from the soil to all parts of the plant.
- * It cools leaf surfaces, sometimes 10 to 15 degrees, by evaporative cooling.
- * It maintains the shape and structure of the plants by keeping cells turgid.

Disadvantages of Transpiration :

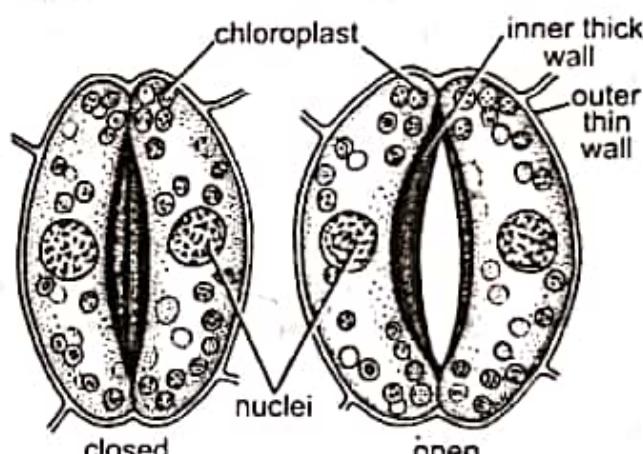
- * Excessive transpiration makes the cells flaccid which retards growth.
- * Excessive transpiration leads to closure of stomata thus obstructing gaseous exchange.
- * Hence it is considered to be a "*necessary evil*".

7. Transpiration and Photosynthesis – a compromise. Explain.

- A. Transpiration has more than one purpose it :**
- * It creates transpiration pull for absorption and transportation of water in plants.
 - * It supplies water for photosynthesis.
 - * An actively photosynthesizing plant has an insatiable need for water.
 - * Photosynthesis is limited by available water which can be swiftly depleted by transpiration.
 - * The evolution of the C₄ photosynthetic system is probably one of the strategies for maximizing the availability of CO₂ while minimizing water loss.
 - * C₄ plant loses only half as much water as a C₃ plant for the same amount of CO₂ fixed.

8. Explain the mechanism of opening and closing of stomata.

A.



Stomata in a surface view

Opening of Stomata :

- * Levitt (1974) proposed K⁺ pump theory.
- * It explains the mechanism of opening and closing of photoactive stomata.
- * According to this theory, K⁺ ions accumulated in guard cells in the presence of light.
- * This coupled with efflux of protons leads to increase in pH of the guard cells.
- * Accumulation of K⁺ ions into the guard cells is associated with passive influx of Cl⁻ ions.
- * It results decreasing the water potential of the guard cells.

- * Water enters into the guard cells, making them turgid.
- * As a result stomata open.

Closing of Stomata :

- * At night, in the absence of light, the K⁺ and Cl⁻ ions move out of the guard cells.

- * Influx of protons occurs.
- * Decrease in the pH of guard cells.
- * Due to which the water potential of guard cells increases.
- * Water starts moving out of them leading to closure of stomata.

2. Mineral Nutrition

VERY SHORT ANSWER QUESTIONS

1. Define hydroponics.
A. The technique of growing plants in a specified nutrient solution
2. Name the essential mineral elements that play an important role in photolysis of water.
A. Manganese, Calcium and Chlorine.
3. Out of the 17 essential elements which elements are called non-mineral essential elements?
A. Carbon, Hydrogen and Oxygen
4. Name two amino acids in which sulphur is present.
A. * Cysteine, * Methionine
5. Name two elements whose symptoms of deficiency first appear in younger leaves
A. * Sulphur, * Calcium
6. Explain the role of the pink colour pigment in the root nodule of legume plants. What is it called ?
A. Pink colour pigment in the root nodule protect the nitrogenase enzyme from oxygen Leghaemoglobin.
7. Which element is regarded as the 17th essential element ? Name a disease caused by its deficiency.
A. * Nickel, * Mouse ear in pecan
8. Name of essential elements present in nitrogenase enzyme. What type of essential elements are they?
A. * Fe and Mo, * Micromineral elements

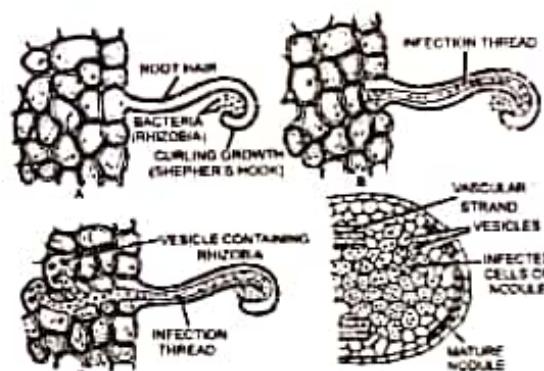
9. Name any two essential elements and the deficiency diseases caused by them.

- A. Boron and Molybdenum.
- * Mo-Whiptail in cauliflower.
 - * B- Heart rot in beets.

SHORT ANSWER QUESTIONS

1. Explain the steps involved in the formation of root nodule.

A.



Development of root nodule in legume

Steps involved in the formation of root nodule :

- * Nodule Formation involves a sequence of multiple interactions between Rhizobium and roots of the host plant.
- * Rhizobium attracted by sugars and Amino acids released by the host legume.
- * Rhizobium multiply and colonise the surrounding of roots and attached to root hair cells of epidermis.
- * The root hairs curl and the bacteria invade the root hair.
- * After infection thread is produced and enter into cortex of root.
- * Then bacteria released from infection thread and enter into cortex.

- * Endodermis and pericycle cells differentiate to form swollen structures known as Nodules.

2. Explain in brief how plants absorb essential elements.

A The mechanism of absorption of elements by plants can be explained by two ways i.e.,

- i) Apoplast
- ii) Symplast

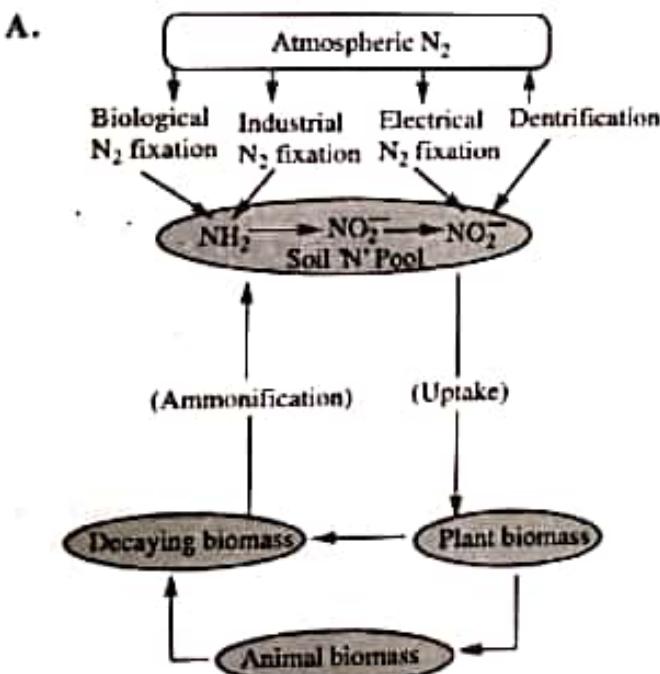
i) Apoplast :

- * It is first phase, in this process there is an initial rapid uptake of ions into the free space or "outer space" of cells.
- * It is a passive movement of ions into the apoplast along the concentration gradient.

ii) Symplast :

- * Uptake of ions occurs slowly into the "inner space" i.e., the symplast of the cells.
- * The entry and exit of ions to and from symplast against concentration gradient, requires metabolic energy which is an active process.
- * The influx and efflux of ions in and out of cells may also occur passively along their individual concentration gradient.

3. Explain the nitrogen cycle, giving relevant examples.



Nitrogen Cycle :

- * Nitrogen cycle described by 5 steps.

* **Nitrogen Fixation :** The process of conversion of molecular nitrogen into ammonia (or) nitrogen oxides, nitrites and nitrates.

* **Nitrogen assimilation :** Chemically binding of NH_4^+ , NO_2^- and NO_3^- with other elements to produce organic nitrogen in plants and thereby into animals.

* **Ammonification :** Decomposition of organic nitrogen of dead plants and animals into ammonia by soil bacteria.

Eg : *Bacillus*

* **Nitrification :** Ammonia is oxidised to nitrites and nitrates by nitrifying bacteria

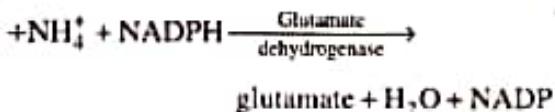
Eg : *Nitrococcus, Nitrobacter*

* **Denitrification :** Nitrates of soil is reduced to nitrogen by bacteria like *Pseudomonas* and *Thiobacillus*.

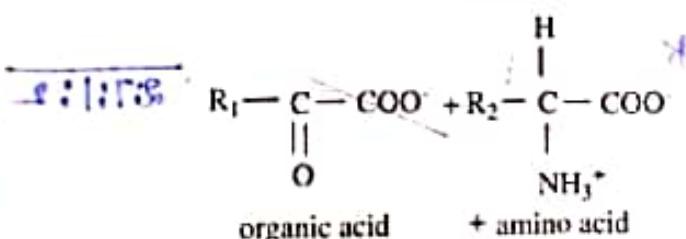
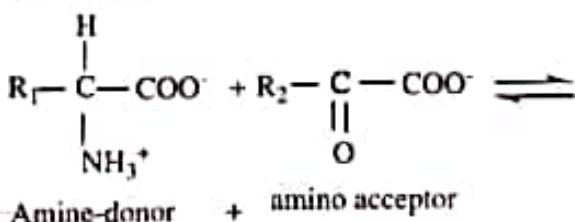
4. Write in brief how plants synthesize amino acids?

A. Plant can synthesize amino acids using NH_4^+ in two ways :

i) **Reductive amination:**- Ammonia reacts with α -ketoglutaric acid and form glutamic acid.
 α -ketoglutaric acid



ii) **Transamination:**- It involves the transfer of an amino group from an amino acid to the keto group of keto acid.

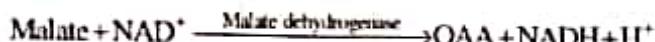


3. Enzymes

VERY SHORT ANSWER QUESTIONS

1. How are prosthetic groups different from co-factors?
- A. Prosthetic groups are organic compounds which are tightly bound to the apoenzyme.
- * Co-factors are non protein part of holoenzyme.

2. What is meant by 'feed-back inhibition'?
- A. The end product of a chain of enzyme catalysed reactions inhibits the enzyme of the first reaction
- * It is a part of homeostatic control of metabolism.
3. Why are 'oxido reductases', so named?
- A. Oxido reductases enzymes catalyses oxidation and reduction between two substrates.
- * Eg:



4. Distinguish between apoenzyme and cofactor.
- A. Protein part of enzyme is called Apoenzyme. Non protein part of Enzyme is called cofactors.
5. What are competitive enzyme inhibitors? Mention one example
- A. Enzyme inhibitors closely resemble the substrate in its molecular structure. It Inhibits the activity of enzyme.
- * Eg : Malonate resembles with succinate.
6. What are non-competitive enzyme inhibitors? Mention one example

- A. Enzyme inhibitors do not show structural similarity with substrate.
- * It forms enzyme inhibitor complex at a point other than active site.

7. What do the four digits of an enzyme code indicate?
27112
- A. First digit of code indicates major class of enzyme
- * Second digit of code indicates subclass of enzyme
- * Third digit of code indicates sub-subclass of enzyme
- * Fourth digit of code indicates serial number of particular sub-subclass.

8. Who proposed 'Lock and key hypothesis' and 'Induced fit hypothesis'?
- A. Lock and key hypothesis – Emil Fischer.
- * Induced fit hypothesis – Koshland.
9. Define Michaelis constant?
- A. Substrate concentration required to cause half the maximal reaction rate.

SHORT ANSWER QUESTIONS

1. Write briefly about inhibitors.
- A. Some Chemicals inhibits the enzyme activity after binding to enzyme are called enzyme inhibitors.
- * Enzyme inhibitors are of 3 types namely.
 - a) Competitive inhibitors
 - b) Non competitive inhibitors
 - c) Feed back inhibitors
- a) **Competitive Inhibitors :** Inhibitor closely resembles the substrate in its molecular structure and inhibit the activity of the enzyme
- b) **Non competitive inhibitors :** Inhibitor binding to Enzyme other than active site and change the globular structure of enzyme
- c) **Feedback inhibitors :** The end product of a chain of enzyme catalysed reactions inhibit the enzyme of the first reaction as a part of homeostasis.
2. Explain different types of cofactors.
- A. **Cofactors :**
 - * Non protein constituents of Enzyme are called cofactors.
 - * Cofactors are of 3 types namely prosthetic group, coenzymes and metal ions.
 - * Prosthetic group-Organic cofactors tightly bound to the apoenzyme. Eg: Haem of peroxidase.
 - * Coenzymes-Organic cofactors loosely bound to the apoenzyme.
Eg : of malate dehydrogenase.
 - * Metal ions-Inorganic cofactor forms coordination bonds with side chains at the active site and substrate
Eg : Zinc for carboxypeptidase.

3. Explain the mechanism of enzyme action.

- A. The catalytic cycle of an enzyme action can be described in the following steps :
- * First, the substrate binds to the active site of the enzyme, fitting into the active site ($E + S$).
 - * The binding of the substrate induces the enzyme to alter its shape, fitting more tightly around the substrate (ES).

* The active site of the enzyme, is close proximity to the substrate can break or make chemical bonds of the substrate and the new enzyme - product complex is formed (EP).

* The enzyme releases the products of the reaction and the free enzyme is ready to bind to another molecule of the substrate and runs through the catalytic cycle once again ($E + P$).



4. Photosynthesis in higher Plants

VERY SHORT ANSWER QUESTIONS

1. Name the process which take place in granal stroma regions of chloroplast ?

- A. Grana - Light reactions
* Stroma - Dark reactions.

6. Of the basic raw materials of photosynthesis, what is reduced? What is oxidised?

- A. H_2O is oxidised.
* CO_2 is reduced.

7. Define the law of limiting factors proposed by Balaman.

A. The rate of process (like photosynthesis) is limited by the factor that is present in a relative minimal value. This factor is called limiting factor.

8. What is the primary acceptor of CO_2 in C_3 plants? What is first stable compound formed in a Calvin cycle?

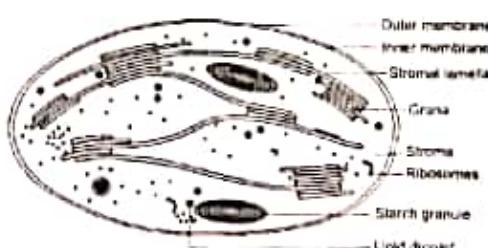
- A. Primary CO_2 acceptor in C_3 plants - RUBP
* First stable compound in C_3 plants- 3-PGA

9. What is the primary acceptor of CO_2 in C_4 plants? What is the first compound formed as a result of primary carboxylation in the C_4 pathway?

- A. Primary CO_2 acceptor in C_4 plants - PEP
* First stable compound in C_4 plants - OAA

SHORT ANSWER QUESTIONS

1. Draw a neat labelled diagram of chloroplast.



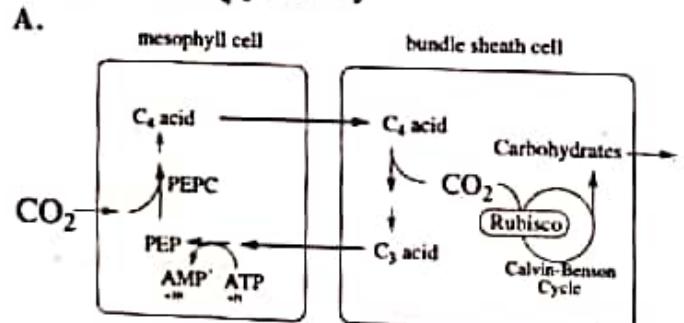
5. Distinguish between action spectrum and absorption spectrum.

Action spectrum	Absorption spectrum
It shows photosynthetic rate at different wavelengths of light.	It shows amount of light absorption by different pigments

2. Tabulate any eight differences between C₃ and C₄ plants/cycles.

C ₃ Plants	C ₄ Plants
1. Kranz anatomy is present	1. Kranz anatomy is absent
2. Single type of chloroplast	2. Two types chloroplasts
3. CO ₂ received by RUBP	3. CO ₂ received by PEP
4. Rubisco performs carboxylation in mesophyll cells.	4. PEP case in mesophyll cells. Rubisco in mesophyll cells. bundle sheath cells.
5. PGA is the first formed product	5. OAA is the first formed product
6. Rate of photo respiration is high	6. Rate of Photorespiration is negligible
7. Photosynthesis stops under conditions water stress	7. Photosynthesis will occur even under water stress condition
8. Photosynthesis does not occur at very low CO ₂ level	8. Photosynthesis will occur even at very low CO ₂ level

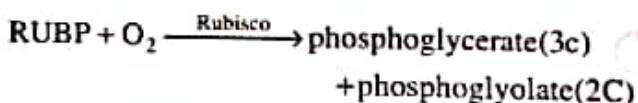
3. Describe C₄ pathway



- * C₄ plants exhibit C₄ cycle. In this first formed product is oxaloacetic acid (OAA).
- * In C₄ plants bundle sheath cells show "Kranz anatomy".
- * The primary acceptor of CO₂ is PEP (phosphoenol pyruvate) in mesophyll cells.
$$\text{PEP} + \text{CO}_2 \xrightarrow{\text{PEPcase}} \text{OAA} + \text{Pi}$$
- * Later malic acid is formed from OAA in chloroplast of mesophyll cells



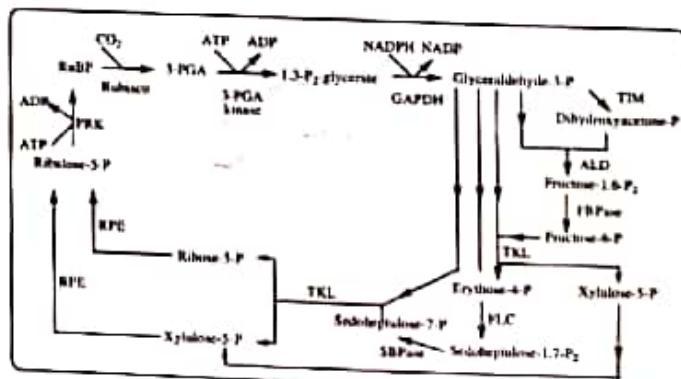
- * After entering of malic acid into bundle sheath cells, it forms pyruvic acid and CO₂.
malic acid $\xrightarrow{\text{breakdown}}$ CO₂ + (3c) pyruvic acid
 - * The pyruvic acid again goes into mesophyll cells and convert into PEP. CO₂ enters into calvin cycle.
4. Describe in brief photorespiration?
- A. In C₃ plants Rubisco enzyme works as both carboxylase (or) as oxygenase.
 - * If oxygenase works fixation of CO₂ decreases.
 - * So at that time instead of 2 molecule of PGA, produces 1 PGA, 1 phosphoglycolate.
 - * It is wasteful process because not producing sugars but it uses ATP.
 - * In C₄ plants only carboxylase function is dominating than oxygenase. So CO₂ can fix as carbohydrates.



LONG ANSWER QUESTIONS

1. Explain calvin cycle

A.



- * Calvin cycle explains about CO₂ fixation in photosynthesis. It is worked out by Calvin and his co-workers.
- * It is present in both C₃ plants and C₄ plants.
- * It occurs in 3 stages.
 - Carboxylation
 - Reduction
 - Regeneration



- i) **Carboxylation** : 6RUBP molecules accept 6CO₂ molecules and converting into 12 molecules of 3-PGA (Phosphoglyceric acid) in presence of RuBisco.
- * 6RUBP + 6CO₂ + 6H₂O $\xrightarrow{\text{RUBISCO}}$ 12,3-PGA
- ii) **Reduction** : This occurs in two steps. In first step 12PGA taking 12 ATP and converting 12 molecules of 1,3 b is PGA (Phosphoglyceric acid) in presence of phosphoglycerokinase.
- * 12 molecules of PGA + 12ATP $\xrightarrow{\text{kinase}}$
 - 12 molecules of 1,3 bisPGA + 12ADP
 - * In 2nd step 12 mol of 1,3 bis phosphoglyceric acid is reduced into 12 molecules of G3P
 - * 12PGA + 12NADPH + H⁺ $\xrightarrow{\text{Dehydrogenase}}$
 - * 12G-3-P + 12NADP⁺ + 12H₂PO₄⁻
- iii) **Regeneration** : 2 molecules of G-3p used to synthesise Hexose in cytoplasm. So 10 G-3-P are used for RUBP regeneration.
- * 4 molecules of -G-3-P $\xrightarrow{\text{isomerase}}$
 - 4DHAP(dihydroxy acetone phosphate)
 - * 2molecules of -G-3-P + 2 molecules of DHAP $\xrightarrow{\text{Aldolase}}$ 2Fructose,1,6 bis phosphate
- V
E
M
L
V
E
M
L
- * 2mol of Fructose - 1,6 - bis phosphate $\xrightarrow{\text{phosphatase}}$
 - 2 mol of Fructose 6 phosphate + 2Pi
 - * 2mol of Fructose - 6phosphate + 2G - 3 - P $\xrightarrow{\text{Transketolase}}$ 2 mol of Xylulose - 5 - phosphate + 2mol Erythrose - 4 - Phosphate
 - * 2E - 4 - p + 2DHAP $\xrightarrow{\text{Aldolase}}$ 2mol of sedoheptulose - 1,7 - bisphosphate
 - * 2mol of Sedoheptulose - 1,7 - bis phosphate $\xrightarrow{\text{phosphatase}}$
 - * 2mol of Sedoheptulose - 7 - phosphate + 2mol G - 3 - P $\xrightarrow{\text{Transketolase}}$ 2 mol of Xylulose - 5 - P + 2mol of Ribose - 5 - Phosphate
 - * 4mol of xylulose - 5 - p $\xrightarrow{\text{epimerase}}$ 4 mol of Ribulose - 5 - P
 - * 2mol of Ribose - 5 - p $\xrightarrow{\text{isomerase}}$ 2 mol of Ribulose - 5 - P
 - * 6mol of Ribulose - 5 - p + 6ATP $\xrightarrow{\text{kinase}}$ 6 mol of Ribulose 1,-5 - P + 6ADP
- Note :** 6 times of cycle gives 1 glucose molecule. 18ATP, 12NADPH required for 6CO₂ molecule fixation.

5. Respiration in Plants

VERY SHORT ANSWER QUESTIONS

1. What is the specific function of F₀-F₁ particles in respiration
- A. F₀-F₁ particles are the two major components of ATP synthase.
- * F₀ acts as proton channel and F₁ is the site of ATP synthesis.
2. What is the common pathway for aerobic and anaerobic respiration? Where does it take place?
- A. Glycolysis.
- * It occurs in cytoplasm of the cell.

3. What cellular organic substances are never used as respiratory substrates?
- A. Pure proteins are never used as respiratory substrates.
4. Why is the RQ of fats less than that of carbohydrates
- A. Fats poorer in O₂ and the proportion of oxygen to carbon in fats is less when compared to Carbohydrates.
- * Fats require more O₂ for complete oxidation so the number of O₂ used is greater than CO₂ released.

5. What is meant by amphibolic pathway?
- A. If a metabolic pathway involves both anabolism and catabolism. It is called amphibolic pathway.
Eg: Respiratory pathway
6. Name the mobile electron carriers of the respiratory electron transport chain in the inner mitochondrial membrane.
- A. * Ubiquinone, * Cytochrome.
7. What is the final acceptor of electrons in aerobic respiration? From which complex does it receive electrons?
- A. Oxygen.
* It receives electrons from complex IV. (Cytochrome C Oxydase).

SHORT ANSWER QUESTIONS

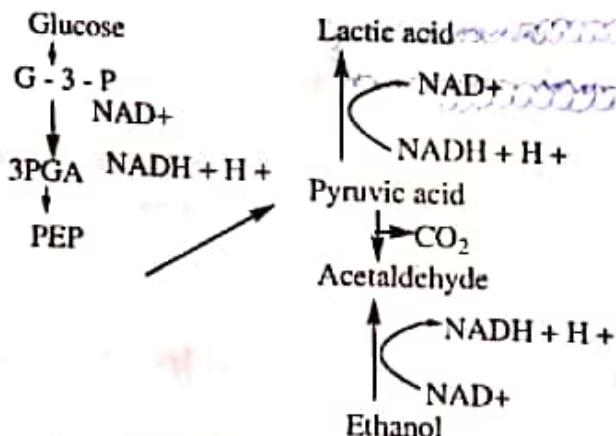
1. Describe briefly the process of fermentation?
- A. Incomplete oxidation of glucose into ethyl alcohol & CO_2 (or) Lactic acid under anaerobic conditions is called fermentation.

Alcoholic fermentation :

- * In yeast pyruvic acid undergoes decarboxylation and reduction and forms ethyl alcohol and CO_2 in the presence of the enzymes pyruvic decarboxylase, alcoholic dehydrogenase

Lactic acid fermentation :

- * In bacteria pyruvic acid form to lactic acid use of enzyme lacticdehydrogenase.



2. Define RQ. Write a short note on RQ
- A. The ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration is called the respiratory quotient (RQ).

$$RQ = \frac{\text{Volume of } \text{CO}_2 \text{ evolved}}{\text{Volume of } \text{O}_2 \text{ consumed}}$$

* When carbohydrates are used as substrate the RQ is 1, because equal amount of CO_2 and O_2 are evolved and consumed.

$$RQ = \frac{6 \text{ CO}_2}{6 \text{ O}_2} = 1.0$$

* When fats are used in respiration the RQ is less than 1

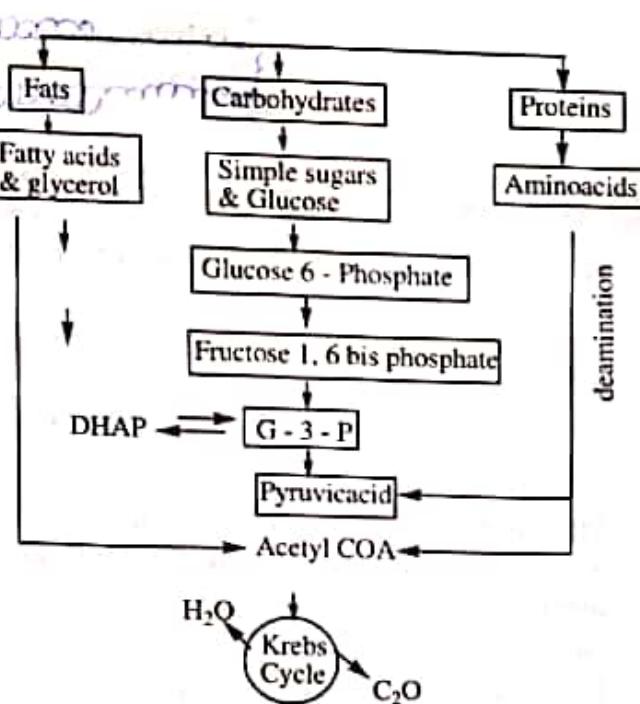
$$RQ = \frac{102 \text{ CO}_2}{145 \text{ O}_2} = 0.7$$

* When protein are respiratory substrates the ratio would be about 0.9

What is meant by amphibolic pathway

- A. If a metabolic pathway involves both anabolism and catabolism it is called amphibolic pathway
example of amphibolic pathway in respiration.
Eg: Respiratory pathway

In respiration fatty acid would be broken down to acetylco-A before entering the respiratory pathway when it is used as a substrate. when organism needs to synthesize fatty acids acetylco-A would be withdrawn from respiratory pathway. Those respiratory pathway participate both in breakdown and synthesis of fatty acids. Similary, during the breakdown and the synthesis of proteins also respiratory intermediates form the link.

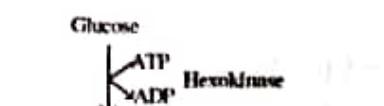


LONG ANSWER QUESTIONS

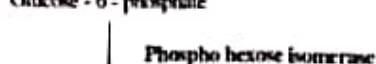
1. Give an account of glycolysis. Where does it occur? What are the end products? Trace the fate of these products in both aerobic and anaerobic respiration?

A.

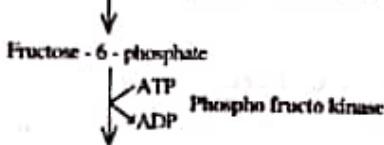
1) Phosphorylation



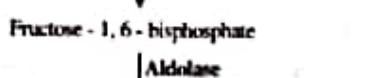
2) Isomerisation



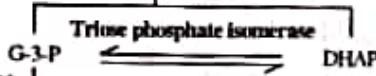
3) Phosphorylation



4) Cleavage



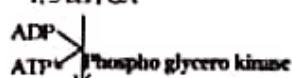
5) Isomerisation



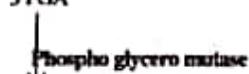
6) Oxidation



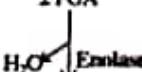
7) Dephosphorylation



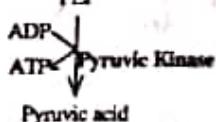
8) Isomerisation



9) Dehydration



10) Dephosphorylation



* Division of Glucose into two pyruvic acid molecules is called glycolysis.

* It occurs in the cytosol of a cell

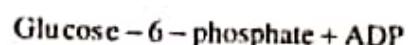
* The various steps of glycolysis pathway were worked out by German scientist Emben, Mayerhoff & paranas, hence it is called 'EMP' - pathway.

Reactions of Glycolysis :

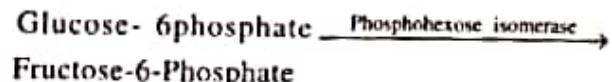
* **Phosphorylation :**

Glucose accepts one ATP molecule and forms glucose-6-phosphate.

* This reaction is catalysed by the enzyme Hexokinase

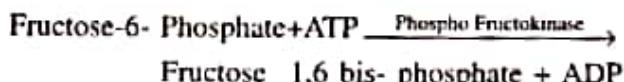


Isomerisation : Glucose - 6- phosphate isomerised to Fructose-6-phosphate in the presence of Phospho hexose isomerase.



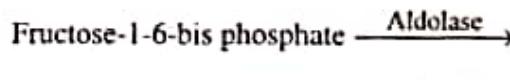
Phosphorylation :

* Fructose-6-phosphate accepts one ATP and forms Fructose 1-6-bis phosphate in the presence of phosphofructokinase enzyme.



Cleavage : Fructose -1-6- bis phosphate is divided into two trioses glyceraldehyde - 3- phosphate and dihydroxy acetone phosphate; in the presence of Aldolase enzyme.

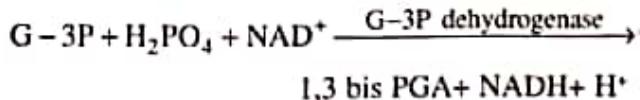
Fructose-1-6-bis phosphate



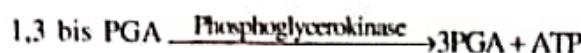
Isomerisation : G3P & DHAP are isomers. Among two trioses only G3P directly participates in the subsequent reactions. Hence DHAP converts into G-3P in the presence of 'triose phosphate isomerase' enzyme.



Oxidation : G-3P undergoes oxidation as well as phosphorylation in the presence of G-3 P dehydrogenase enzyme resulting in the formation of 1,3 - bis phosphoglyceric acid and NADH.

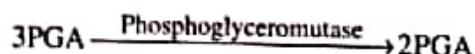


Dephosphorylation : Removal of an inorganic phosphate from 1,3 bis PGA results in the formation of 3 PGA in the presence of Phosphoglycerokinase.



Inorganic phosphate released in this process accepted by ADP to form ATP. This process of ATP formation is called as 'Substrate level phosphorylation'.

Isomerisation (Intramolecular shift) : Inorganic phosphate in 3PGA transfers from its 3rd carbon to 2nd carbon and forms 2 PGA in the presence of phosphoglyceromutase.

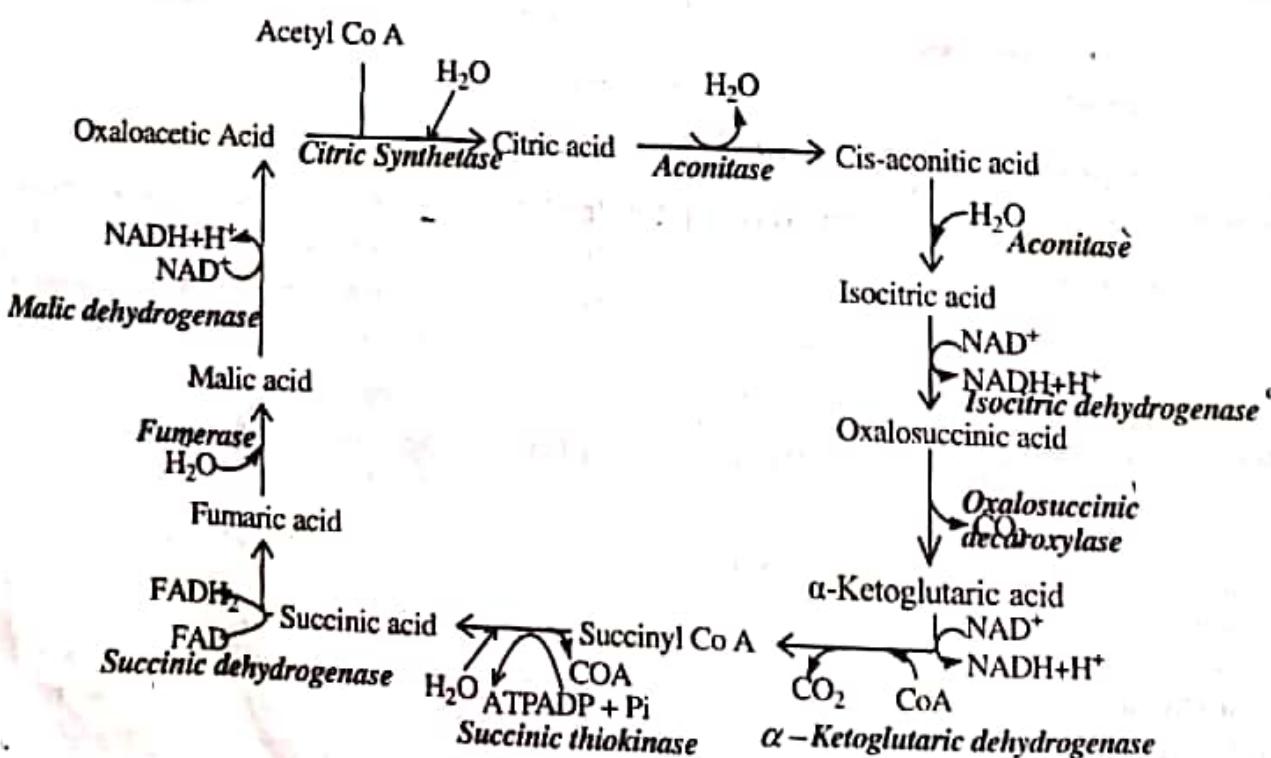


Dehydration : Removal of one water molecule from 2 PGA resulting in the formation of PEP, (Phospho enolpyruvic acid) in the presence of 'enolase'.

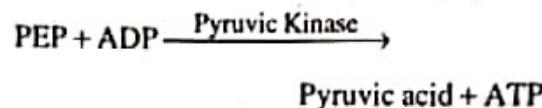


2. Explain the reactions of krebs cycle?

A. Krebs Cycle :



De Phosphorylation : Removal of an inorganic phosphate from PEP results in the formation of pyruvic acid in the presence of Pyruvic kinase. Inorganic phosphate accepted by ADP to form ATP. Hence it is substrate level phosphorylation.



End products of Glycolysis :

2 Pyruvic acid molecules

4 ATP molecules are formed but 2 are utilized in 1st & 3rd steps. So net gain of 2 ATP.

2 NADH+ H⁺.

Fate of Pyruvic acid :

Pyruvic acid fate depends upon the availability of oxygen.

In the presence of oxygen it is completely oxidized into CO₂ & H₂O.

In the absence of oxygen pyruvic acid is converted to ethyl alcohol by fermentation.

- * The acetyl CoA enter into the (Mitochondrial Matrix) cyclic pathway called TCA cycle. It is commonly called Krebs cycle.
- * Krebs cycle 1st discovered by Hans Krebs
- * Krebs includes 10 steps

Condensation : In these acetyl COA condenses with OAA and water to yield citric acid in the presence of citrate synthetase enzyme and COA is released.



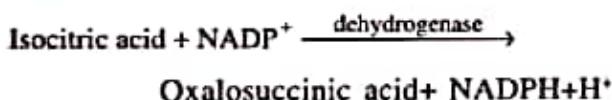
Dehydration : Citric acid loses of water molecule to yield cis-aconitic acid in the presence of enzyme aconitase.



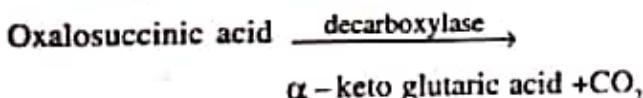
Hydration : Water molecule is added to CAA (cis aconic acid) to yield isocitric acid in the presence of enzyme aconitase.



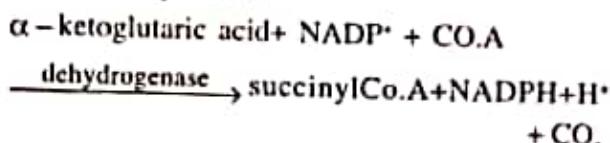
Oxidation -I : Isocitric acid undergoes oxidation in the presence of dehydrogenase enzyme to yield succinic acid.



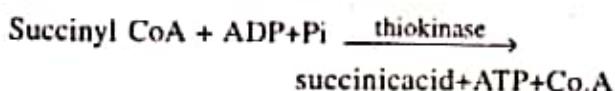
Decarboxylation : (OSA) oxalosuccinic acid undergoes decarboxylation in the presence of decarboxylase to form α -keto glutaric acid.



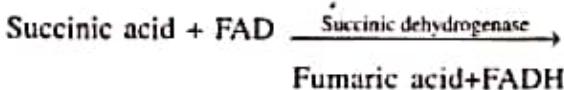
Oxidation- II : α -ketoglutaric acid undergoes oxidation and decarboxylation in the presence of dehydrogenase and condenses with CO.A form succinyl Co.A



Cleavage : Succinyl Co.A splits into succinic acid and Co.A in the presence of thiokinase to form succinic acid. The energy released is utilised to from ATP from ADP and IP.



Oxidation -III : Succinic acid undergoes oxidation and forms fumaric acid in the presence of succinic dehydrogenase.



Hydration : A water molecule is added to fumaric acid the presence of fumarase to form malic acid.



Oxidation -IV : Malic acid undergoes oxidation in the presence of malic dehydrogenase to form OAA.



- * In TCA cycle every 2 molecules of acetyl Co.A undergoes oxidation and gives 2ATP, 6 NADH+H+, 2FADH₂ and 4 CO₂ molecules.

6. Plant Growth and Development

VERY SHORT ANSWER QUESTIONS

1. Define plasticity, Give an example.
- A. Plants show different pathways in responses to different environment to form different kinds of structures.
- * Eg : i) Development heterophyly in cotton, coriander

- * ii) Environmental heterophyly in buttercup (*Ranunculus*).
2. What is the disease that formed the basis for the identification of gibberellins in plants? Name the causative fungus of the disease.
- A. The "BAKANE" (foolish seedling) disease of rice seedling.
- * *Gibberella fujikuroi*

- 3. What is apical dominance? Name the growth hormone that causes it ?**
- A. Inhibition of the growth of lateral (axillary) buds by growing apical bud called apical dominance.
- * Auxins.
- 4. What is meant by bolting? Which hormone causes bolting?**
- A. The internodal elongation just prior to flowering in Beet, Cabbages is called bolting.
- * Gibberellins.
- 5. Define respiratory climactic. Name of the PGR associated with it.**
- A. Rise in the rate of respiration during ripening process of fruits is called respiratory climatic
- * Ethylene.
- 6. What is ethephon? Write its role in agricultural practices.**
- A. Ethephon is a compound used as source of ethylene. Ethephon releases ethylene slowly.
- * Ethephon promotes fruit ripening in tomatoes, apples. Abscission in flowers and fruits & promotes female flowers formation in cucumbers.
- 7. Which of the PGRs is called stress hormone and Why?**
- A. Abscisic acid (ABA).
- * At various kinds of stress, ABA stimulates the closure of stomata and increase the tolerance to stress conditions.
- 8. Define the terms quiescence and dormancy?**
- A. **Quiescence :** It is the inability of a seed to germinate due to unfavourable external conditions.
- * **Dormancy:** It is the failure of a seed to germinate due to unfavourable internal conditions, even though external conditions are suitable.
- * Auxins promote flowering in Pineapples.
- * Prevent fruit and leaf drop at early stages but promote the abscission of older mature leaves and fruits.
- * Auxins responsible for apical dominance.
- * Auxins induce parthenocarpy in Tomatoes.
- * Auxins are used as herbicides. Eg : 2,4-D
- 2. Write the physiological response of gibberellins in plants?**
- A. Gibberellins are used to increase the length of grapes stalks.
- * Helps in delaying of senescence.
- * Gibberellins elongate and improve the shape of apple.
- * In sugarcane crop, increases the length of stem, & increases the yield by 20 tons per acre.
- * Gibberellins speeds up maturity period, leading to early seed production.
- * Promote bolting in beet and cabbages etc..
- 3. Write any four physiological effects of cytokinins in plants.**
- A. Cytokinins help to produce new leaves & chloroplasts in leaves
- * Helps in lateral shoot growth and adventitious shoot formation.
- * Helps to overcome the apical dominance.
- * Promote nutrient mobilization which helps in the delay of leaf senescence.
- 4. What are the physiological processes that are regulated by ethylene in plants?**
- A. Horizontal growth of seedlings, swelling of the axis and apical hooks formation in dicot seedlings.
- * Ethylene promotes senescence, abscission of plant organs.
- * Ethylene is highly effective in fruit ripening.
- * Ethylene breaks seed and bud dormancy and initiates sprouting of potato tubers.
- * Ethylene promotes root growth and root hair formation.
- * Ethylene is used to initiate flowering and for synchronising fruit set in pineapples.

► SHORT ANSWER QUESTIONS

- 1. Write a note on agricultural/ horticultural applications of auxins.**
- A. Auxins help to initiate rooting in stem cuttings used for plant propagation in horticulture.

5. Write short notes on seed dormancy.
- A. **Dormancy:** The failure of a seed to germinate due to unfavourable internal conditions, even though external conditions like temperature, moisture are suitable called dormancy.
- * The dormancy of seed may be caused by hard seed coat. Eg : Fabaceae.
 - * Dormancy caused by hard seed coats can be broken by scarification.
 - * Seeds of plants like tomato contain chemical compounds, which inhibit their germination.
 - * Seed germination may be inhibited if embryo fails to reach morphological maturity.
Eg : Ranunculus.

6. Describe briefly

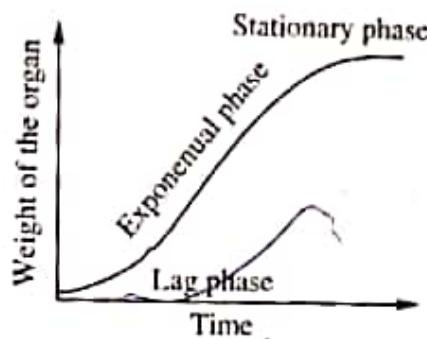
- a) Sigmoid growth curve
- b) Absolute and relative growth rates.

A. (a) **Sigmoid growth curve:**

- (i) If a graph is plotted for geometrical growth, gives typical sigmoid or S-curve.

(ii) It exhibits three phases

- * Lag phase
- * Log (or) Exponential phase
- * Stationary phases



(b) **Absolute and relative growth rates :**

- I) **Absolute growth rate:** Measurement and comparison of the total growth per unit time is called the absolute growth rate.
- II) **Relative growth rate:** The growth of the given system per unit time as percentage of initial size is called the relative growth rate (RGR)

$$\text{RGR} = \frac{\text{Growth per unit time}}{\text{Initial size}} \times 100$$

UNIT-II

MICROBIOLOGY

7. Bacteria

VERY SHORT ANSWER QUESTIONS

1. Name the bacteria which is a common inhabitant of human intestine. How is it used in biotechnology?
- A. *Escherichia.coli*
- * It is used as host cell for cloning vector.
 - * Eg : cloning of antibiotic resistance gene.
2. What are pleomorphic bacteria? Given an example.
- A. Bacteria which changes its shape according to environmental changes.
- * Eg : *Acetobacter*
3. What is sex pilus? What is its function?
- A. Small fibers like structures present on bacterial cell called sex pili.
- * They help in conjugation by formation of conjugation tube.

4. What is genophore?

- A. chromosomal material of prokaryote and it is main genetic material.

5. What is plasmid? What is its significance?

- A. Extra chromosomal circular ds DNA in cytoplasm is called as plasmid.

- * confer protective features such as Antibiotic resistance.

- * Helps in production of enzymes and toxins.

6. What is conjugation? Who discovered it and in which organism?

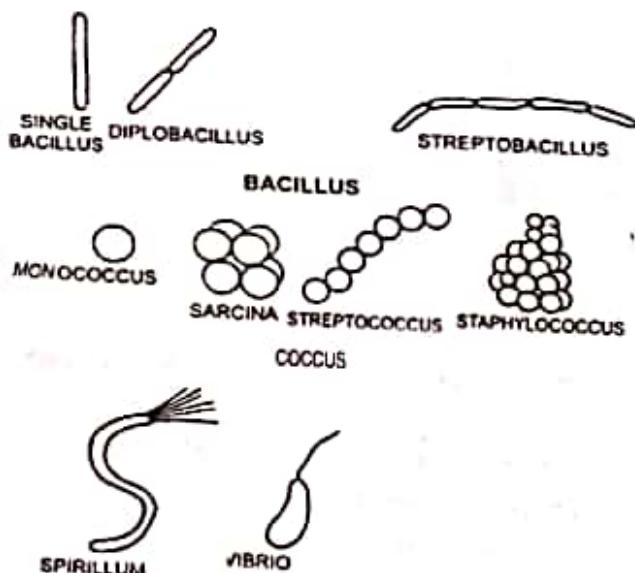
- A. Transfer of genetic information between two bacterial cell through cell to cell direct contact (conjugation tube) is called as conjugation.

- * Discovered by Lederberg & Tatum in *Escherichia.coli*

7. What is transformation? who discovered it and in which organism?
- A. Uptake of naked ds DNA from environment by competitive bacterial cell is called as transformation.
- * Discovered by Frederick grifith in
 - * *Streptococcus pneumoniae*
8. What is transduction? Who discovered it and in which organism?
- A. Transfer of genetic material from one bacteria to other with the help of virus is known as transduction.
- * Discovered by Lederberg and Zinder in *Salmonella typhimurium*

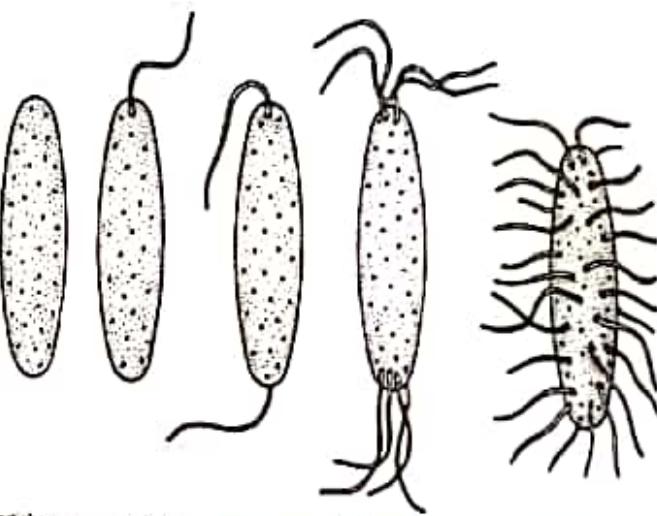
SHORT ANSWER QUESTIONS

1. How are bacteria classified on the basis of morphology?
- A. Size-ranges between $2.0\mu\text{m}$ - $5\mu\text{m}$ Rigid cell wall determines the shape of bacterial cell.



- * Classification of bacteria on shape
- i) Coccii-round or spherical cells
- ii) Bacilli-rod shape
- iii) Vibrios-comma shape
- iv) Spirillum-cells that have more than one complete twist.

- v) Pleomorphic-not having disint shape
Eg: *Acetobacter*
 - vi) Filamentous-thread like.
Eg: *Actinomycetes, Beggiota*
2. How are bacteria classified on the basis of number and distribution of flagella?
- A. Based on flagella bacteria are classified into four categories



- i) Monotrichous-single flagella on one side
- ii) Amphitrichous-on both the ends of the cell single flagella is present.
- iii) Lophotrichous-bunch of flagella at only one end of bacterial cell.
- iv) Peritrichous-complete cell is covered with flagella.
- v) Atrichous-cells without flagella
- vi) Function of flagella is locomotion

3. What are the nutritional groups of bacteria based on their source of energy and carbon?
- A. (i) Photoautotrophs

- * source of energy - sunlight
- * carbon source - atmospheric CO_2
- * Eg: *Chlorobium*

- (ii) Chemoautotrophs

- * source of energy - oxidation of inorganic substances
- * carbon source - atmospheric CO_2
- * Eg: *Nitrosomonas*

(iii) Photoheterotrophs

- * source of energy - sun light
- * carbon source - organic substances
- * Eg: *Rhodospirillum*

(iv) Chemoheterotrophs

- * carbon & energy source is organic composed
- * Eg: *Xanthomonas*

(v) Chemoheterotrophs are categorised into two groups

- i) Saprophytes ii) Parasites

4. Explain the conjugation in bacteria.

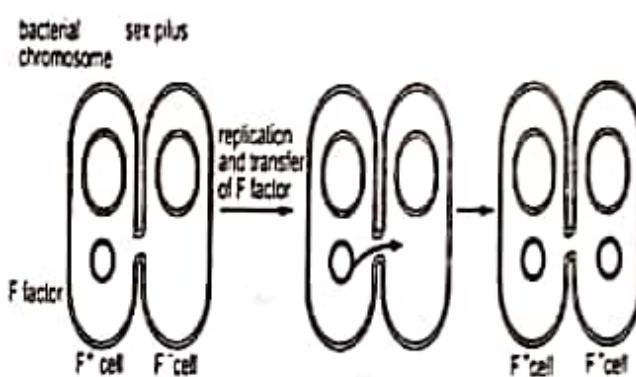
- A. (i) Transfer of genetic information between two bacterial cells by direct cell to cell contact through conjugation tube is called as conjugation.
(ii) It is discovered by Lederberg & Tatum in E-coli.
(iii) Donor is called as F⁺ and acceptor is called as F⁻

(iv) Donor cell contain F plasmid

(v) F⁺ cells with help of pilus contact with F⁻ cells.

(vi) After contact F plasmid of F⁺ cells undergoes Replication & Replicated DNA pass through conjugation tube into F⁻ cells.

(vii) After conjugation F⁻ cells are converted into F⁺.
(viii) Conjugation is a conservative process.



8. Viruses

VERY SHORT ANSWER QUESTIONS

1. What is the shape of T₄ Phage? What is its genetic material?

A. Tadpole Shape.

* Double stranded DNA

2. What are virulent phages? Given an example?

A. Phages which follows lytic type of life cycle are called as virulent phages

* Eg: T even phages

3. What is lysozyme and what is its function?

A. Lysozyme is a viral encoded catalytic protein (enzyme).

* It breaks bacterial cell wall.

4. Define 'lysis' and 'burst size' with reference to various and their effects on host cells.

A. Lysis-Breaking of bacterial cell wall by viral encoded lysozyme is called as lysis.

* Burst size-Average number of viral particles released at the end of lytic cycle from single bacterium. Usually ranges between 50-200/cell.

5. What are temperate phages? Give one example.

A. A bacteriophage which follows lysogenic type of life cycle are called as temperate phages

* Eg: λ phages.

6. Mention the difference between virulent phages and temperate phages.

	Virulent Phages	Temperate Phages
	Follows lytic type of life cycle.	Follows lysogenic type of life cycle.
	Prophage is absent	Prophage is present
	Eg: T even phages	Eg: λ phages

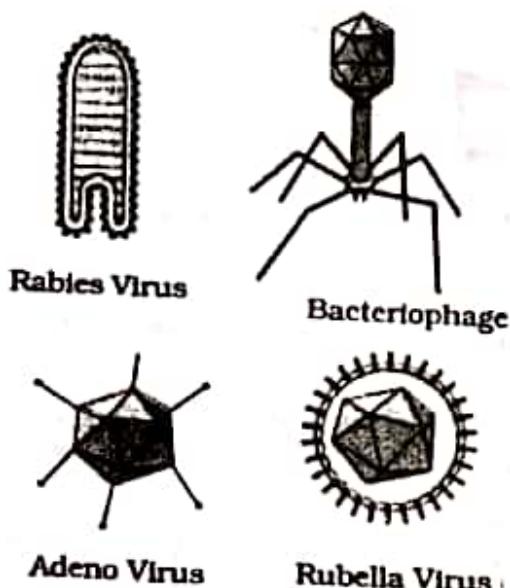
7. What is the shape of TMV? What is its genetic material?

A. Rod shaped Helical virus.

* Single stranded RNA.

SHORT ANSWER QUESTIONS

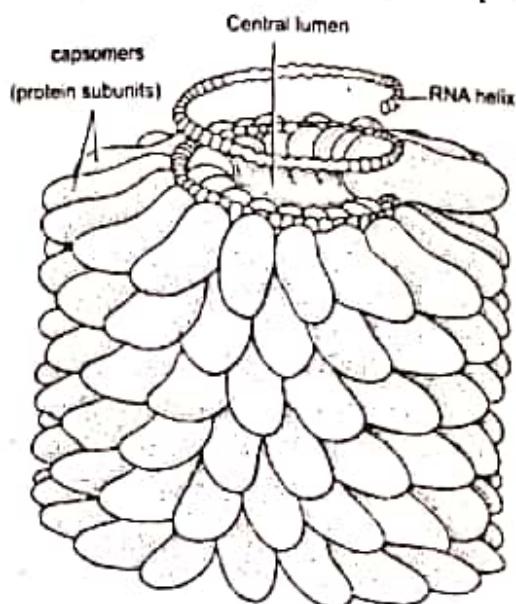
- Explain the chemical structure of viruses.
- A. Viruses are small nucleocapsids.
- Contains either DNA or RNA but not both, as their genetic material.
 - Genetic material surrounded by protein coat called as capsid.
 - Capsid is made of protein subunits called as Capsomeres.
 - Generally plant viruses contain ssRNA as genetic material.
 - Generally animal viruses contain dsDNA as genetic material.
 - Viral nucleic acids are either circular or linear.
 - Symmetry of capsid decides the shape of virus.
Helical virus : Eg: TMV



2. Explain the structure of TMV.

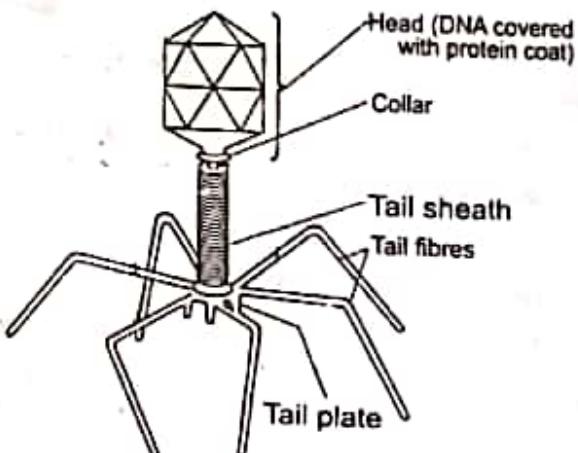
- A. TMV is a helical long rod like flexible RNA virus.
- Length is 300nm & Diameter is 18 nm with M.W 39×10^6 daltons.
 - Capsid contains 2,130 protein subunits arranged in helical fashion, with central hollow space of 4nm called as core.

- Each capsomer is made of single polypeptide chain containing 158 amino acids.
- Inside the core region Single stranded spirally coiled RNA with 6,500 nucleotides is present.



3. Explain the structure of T-even bacteriophages.

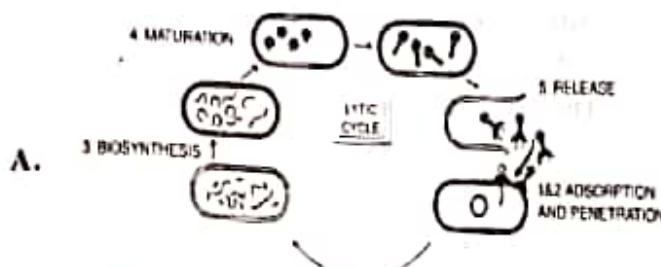
A.



Structure of bacteriophage

- Structure: Tadpole appearance.
- Contains head (icosahedral) & helical tail joined by collar
- Inside capsid double stranded DNA is present.
- Around tail core contractile tail sheath is present.
- At the end of tail, basal plate is present.
- Basal plate contains, 6 pins & 6 tail fibres which helps in attachment of virus to host cell.

4. Explain the lytic cycle with reference to certain viruses.



- * T-even phages follow lytic type of life cycle & these are called as virulent phages.
- * It involves 5 steps:

a) **Attachment:** Phage attaches to host cell wall on complementary receptor by its tail fibers.

b) **Penetration:** With contraction of tail sheath DNA of virus injected into host cell.

The capsid remains outside the bacterial cell it is called as ghost.

c) **Biosynthesis:** Viral DNA takes control over host cellular machinery & produces its own proteins.

d) **Maturation:** Phage DNA & Proteins are assembled to form a complete viral particle.

e) **Lytic phage:** Viral encoded lysozyme cleaves bacteria releases viral particles/virions.

UNIT-III

GENETICS

9. Principles of Inheritance and Variation

VERY SHORT ANSWER QUESTIONS

1. What is the cross between F_1 progeny and the homozygous recessive parent is called? How is it useful?

A. Test cross.

- * Helps to know the genotype of F_1 individual

2. Who proposed the Chromosome theory of inheritance?

A. Walter Sutton and Theodore Boveri

3. Define true breeding. Mention its significance?

A. Production of homozygous progeny through repeated self-pollination is called true breeding.

- * Desirable traits can transfer for several generations without segregation.

4. Explain the terms phenotype and genotype?

A. Phenotype is physical appearance of an organism

- * Genotype is genetic makeup of an organism.

5. What is point mutation? Give an example.

A. Mutation due to change in a single base pair of DNA.

- * Eg: Sickle cell anemia.

6. What will be the phenotypic ratio of the offspring obtained from the following cross?

A. Note: Gene A is dominant Over gene a.

A) $Aa \times aa = 1 : 1$

B) $AA \times aa = 1 : 0$

C) $Aa \times Aa = 3 : 1$

D) $Aa \times AA = 1 : 0$

7. In garden pea, the gene T for tall is dominant over allele for dwarf. Give the genotypes of the parents in the following crosses. A, Tall \times Dwarf producing all tall plants. B, tall \times tall producing 3 tall and 1 dwarf plants.

A. A) TT \times tt B) Tt \times Tt

SHORT ANSWER QUESTIONS

1. Mention the advantages of selection pea plant for experiment by Mendel?

A. It is an annual plant with well defined characters

- * It can be grown easily.

* It has bisexual flowers so self pollination possible.

- * It can be crossed easily.

* It has short life cycle.

- * It produces large number of offsprings.

2. Differentiate between the following ?

- (a) Dominant and recessive
- (b) Homozygous and heterozygous

Dominant	Recessive
Allele of a gene can be expressed in homozygous/heterozygous state Phenotype is expressed in F_1 generation	Allele only expresses in homozygous state. Phenotype is not expressed in F_1 generation
Homozygous	Heterozygous
Identical alleles for a single character Ex:- TT for tall	Two dissimilar alleles for a single character Ex:- Tt for tall

3. Explain the law of Dominance using a monohybrid cross.

- A. Characters coded by discrete units called factors
Eg : Character - Height [allels] - T/t.
- * Factors occurs in pairs, which can be similar or dissimilar. Pairs.
Similar Pair - TT/tt, Dissimilar pair - Tt.
- * In a pair dissimilar of factors (Tt) one factor of pair dominates (T) the other factor (t).

Monohybrid cross :

- * Cross pollination between true breeding tall and dwarf plant, result all tall plants in F_1 generation.
- * Self pollination in F_1 plants result in F_2 progeny.
- * The F_2 progeny show 3: 1 ratio of dominant trait and recessive trait.

TT \times tt (parents)

Tt \rightarrow F_1 generation

Self pollination of F_1 progeny

Tt \times Tt

	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (Dwarf)

4. Define and design a test-cross ?

- A. Crossing of F_1 individual dominant phenotype with its homozygous recessive parent is called test cross.

- * The test cross used to know the genotype of F_1 dominant phenotype.

Example: 1. When a tall plant (TT) is crossed with dwarf plant (tt) in F_1 progeny all plants will be tall.

2. A tall plant can be of Homozygous or Heterozygous.

3. To know genotype of F_1 progeny F_1 is crossed with recessive plant.

4. After crossing if progeny are with 1:1 ratio of tall and dwarf plants, then F_1 will be heterozygous.

TT \times tt

Tt - F_1 progeny

Tt \times tt (Recessive parent)

Male / Female	t
T	Tt
t	tt

5. Explain the Co-dominance with example ?

- A. Codominance : It is the phenomenon of two alleles lacking dominant-recessive relationship and both expressing themselves in the organism

Eg: (i) When a cross is made in lentil (*Lens culinaris*) between pure breeding spotted and dotted phenotypes.

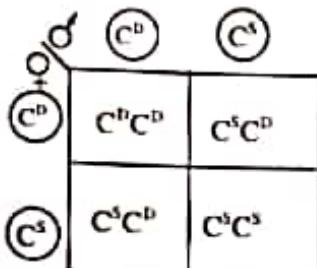
(ii) The F_1 heterozygotes resulted with both spotted and dotted phenotypes.

(iii) On self pollination of F_1 plants, the F_2 plants showed the phenotypes as 1 spotted: 2 spotted & dotted: 1 dotted.

(iv) The heterozygotes differ from both the homozygotes parents in phenotype and genotype and hence both phenotypic and genotypic ratio is same 1:2:1.

$C^D C^D \times C^S C^S$ (parents) $C^D C^S$ (F₁ generation) $C^D C^S \times C^D C^S$ (self pollination) $C^S C^S : C^S C^D : C^D C^D$ (F₂ generation)

1 : 2 : 1

 $C^S C^S$ (spotted) $C^S C^D$ (spotted & dotted) $C^D C^D$ (dotted)

6. Explain the incomplete dominance with example.

- A. Incomplete dominance neither the allele of a gene is dominant nor recessive. So that heterozygote show intermediate trait between the two parental traits.
- * In four 'O' clock plants Red colour flower producing plant is crossed with white flower producing plant.

- * In F₁ generation all progeny form pink coloured flowers intermediate.
- $RR \times rr$
Red White
- F₁ progeny $\rightarrow Rr$ pink colour flowered progeny
- * Self pollination of F₁ progeny result in Red, pink, white, flowers in 1:2:1 ratio
- * Phenotypic ratio = genotypic ratio

	R	r	
R	RR	Rr	RR- Red 1
r	Rr	rr	Rr- pink 2

rr- white 1

7. Define Law of segregation and Law of independent Assortment?

- A. **Law of segregation** : 1. Among a pair of alleles of a gene in heterozygous condition they will not blend / fuse but they segregate equally into gametes during meiosis.
2. So chance of having dominant allele/ recessive allele in a gamete will be 50%.

Law of independent Assortment : When the plants differ from each other in two or more pairs of contrasting characters or factors then inheritance of one pair of factors is independent to that of other pair of factors.

- * Hence four types of gametes are produced in equal proportion by dihybrid.

UNIT-IV MOLECULAR BIOLOGY

10. Molecular Basis of Inheritance

VERY SHORT ANSWER QUESTIONS

1. Distinguish between heterochromatin and euchromatin. Which of the two is transcriptionally active.
- A. Heterochromatin : It is darkly stained and densely packed part of chromatin.
- * Euchromatin : It is lightly stained and loosely packed part of chromatin.
 - * Euchromatin is transcriptionally active.

2. Who proved that DNA is genetic material ? What is the organism they worked on?
- A. Alfred Hershey and Martha Chase (1952)
- * On Bacteriophages.
3. What are the components of a nucleotide?
- A. Nucleotide has three components.
- * A nitrogenous base.
 - * A pentose sugar.
 - * A phosphate group.

4. $5' AATGCAGCTATTAGG 3'$

Write the sequence of

- (a) its complementary strand
- (b) the mRNA

A. (a) complementary strand :

$3' TTA\text{C}GTCGATAATCCS 1'$

(b) mRNA : $5' AAU\text{G}CAG\text{C}UAUUAGG 3'$

5. Name any three viruses which have RNA as the genetic material.

- A. * Tobacco Mosaic virus.
- * QB bacteriophage.
- * HIV

6. What are the components of a transcription unit?

- A. The components of a transcription unit are
- * A promoter.
- * The structural gene.
- * A terminator.

7. What is the difference between exons and introns ?

- A. Exons are coding sequences that appear in mature or processed mRNA.
- * Introns are non coding sequences and not appear in mature or processed mRNA.

8. What is meant by capping and tailing ?

- A. Capping :- Addition of methyl guanosine triphosphate (mG_{PPP}) at $5'$ end of hn RNA.
- * Tailing :- Addition of adenylate residues (200-300) at $3'$ of hn RNA.

9. What is meant by point mutation? Given an example.

- A. Change in a single base pair of DNA is called point mutation.
- * Eg: Sickle cell anemia(change of Glutamate to valine).

10. What is meant by charging of t RNA ?

- A. Amino acids are activated in presence of ATP and are linked to their related t RNA is known as charging of t RNA.

11. Define stop codon. Write the stop codons

- A. The codon of mRNA which not code any amino acid and help to stop translation is called stop codon.

* Stop codons are UAA, UAG, UGA

12. Write any two chemical difference between DNA and RNA.

DNA	RNA
(i) It consists thymine	(i) It consists uracil
(ii) Deoxyribose sugar present	(ii) Ribose sugar present

SHORT ANSWER QUESTIONS

1. How many types of RNA polymerases exists in cells ? Write their names and functions.

A. There are four Types of RNA polymerases in eukaryotic cell.

* RNA polymerase I— It transcribes r RNAs (28S, 18S and 5.8S).

* RNA polymerase II- It transcribes hn RNA.

* RNA polymerase III-It transcribes t RNA, 5S r RNA and 5.8S r RNA.

* RNA polymerase of cell organelles.

2. What is the contributions of George Gamow, H.G. Khorana, Marshall Nirenberg in deciphering the genetic code ?

A. George Gamow suggested that each codon must contain three nucleotides which generate 64 codons sufficient to code all 20 amino acids.

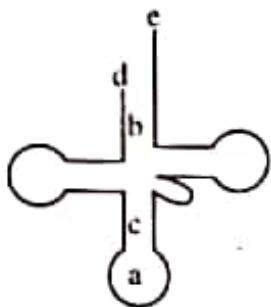
* H.G. Khorana synthesised RNA molecule with homopolymers such as UUU and copolymers such as UUC, CCA.

* Marshall Nirenberg synthesised protein in cell free system.

3. On the diagram of the secondary structure of tRNA shown below label the location of the following part

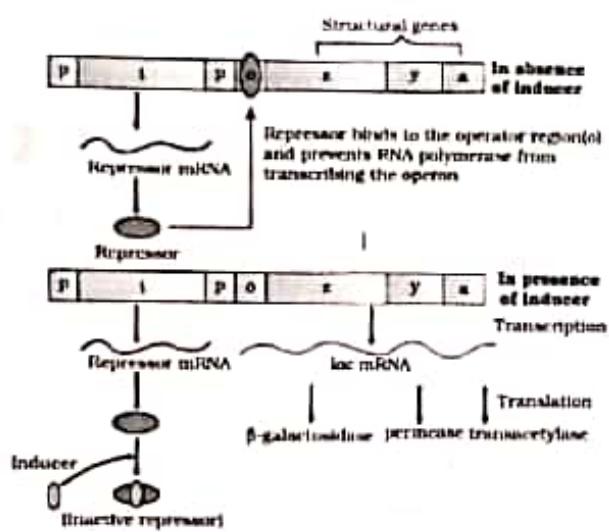
- (a) Anticodon
- (b) Acceptor stem
- (c) Anticodon stem
- (d) 5'
- (e) 3' end

A.



4. Draw the schematic diagrammatic presentation of the lac operon.

A.



5. What are the differences between DNA and RNA

A.

DNA	RNA
i) Usually double stranded	i) Usually single stranded
ii) Deoxyribose sugar present	ii) Ribose sugar present
iii) Thymine is present	iii) Uracil is present
iv) DNA is genetic	iv) RNA is non-genetic material except in some viruses.
v) Metabolically it is one type	v) Metabolically it is three types

6. Write the important features of Genetic code?

A. Features of Genetic code

- * **Code is a triplet :** It consists 3 nucleotides. 61 codons code 20 types of amino acids.
- * **Code is unambiguous :** One codon codes for only one amino acid.
- * **Code is degenerate :** Some amino acids are coded by more than one codon.

Code is continuous :

- * The code is nearly universal except in mitochondria and some protozoans.
- * **Initiator codon :** AUG has dual function It codes for Methionine and act as initiator codon.
- * **Stop codons :** UAA, UAG, UGA are stop codons.
- 4. **The Genetic code is non-overlapping**
- 7. Write briefly on nucleosome.

A. The nucleosome in chromatin appear as beads on-string.

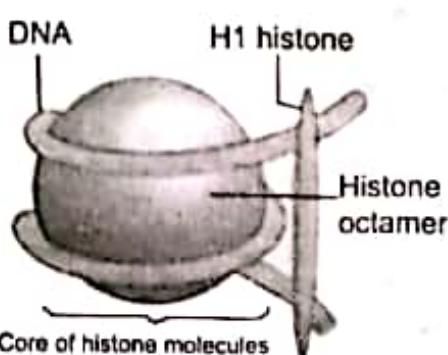
In nucleosome the negatively charged DNA is wrapped around the positively charged Histone octamer.

A typical nucleosome contains 200 bp of DNA.

Histone octamer contains H₂A, H₂B, H₃, H₄ two copies of each.

H₁ histone molecule is present outside of the histone octamer.

In between two nucleosomes linker DNA present.



11. Principles and Process**VERY SHORT ANSWER QUESTIONS**

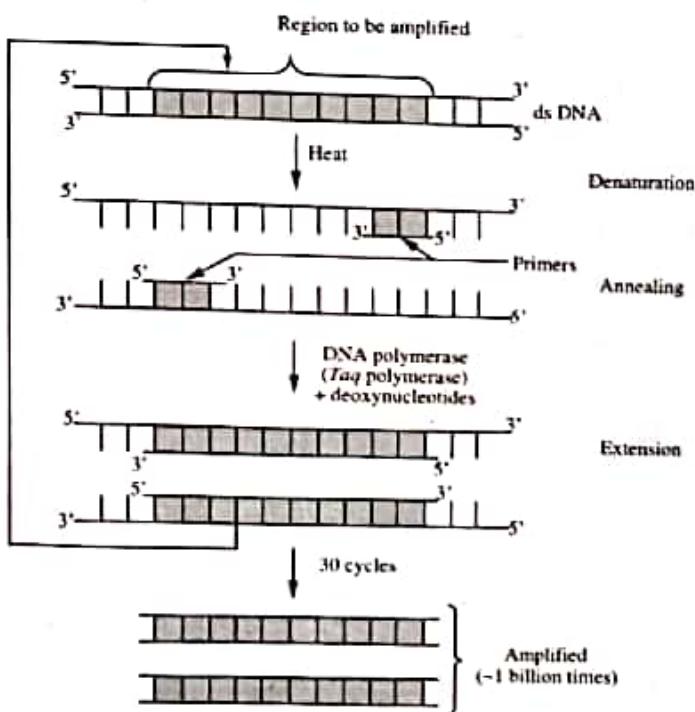
- What are molecular scissors? Where are they obtained from?
A. Restriction endonucleases are called as molecular scissors due to their ability of cleavage of DNA molecules.
- * Bacteria
- Name any two artificially restructured plasmids.
A. P^{BR322} , P^{UC19} , P^{UC101}
- What is EcoRI ? How does it function?
A. EcoRI is restriction endonuclease enzyme obtained from E. coli.
* It recognises $5'$ GAATTC $3'$
 $3'$ CTTAAG $5'$
palindromic sequence and cut the DNA in between G and A and form sticky ends.
- What are cloning vectors? Give an example.
A. Vectors used for multiplying the foreign DNA sequences are called cloning vectors.
* Plasmids, cosmids
- What is palindrome sequence?
A. The sequence of base pairs of DNA that reads same on the two strands when orientation of reading is kept the same
* Eg: $5'$ GAATTC $3'$
 $3'$ CTTAAG $5'$
- What is full form of PCR? How is it useful in biotechnology?
A. PCR : Polymerase chain reaction.
* It is useful for amplification of gene of interest in biotechnology.
- What is down-stream processing?
A. Separation and purification of foreign gene product in biotechnology is called as down stream process.

- How does one visualize DNA on an Agar gel?
A. Staining of DNA with ethidium bromide followed by exposure to UV radiation gives bright orange colour to the separated DNA bands.
- How can you differentiate between exonucleases and endonucleases.
A. Exonucleases : These enzymes remove nucleotides from the ends of the DNA.
* Palindromic sequences are not required.
Endonucleases : These enzymes cut the DNA at specific positions within the DNA.
* Palindromic sequences are required.

SHORT ANSWER QUESTIONS

- Give an account of amplification of gene of interest using PCR.

A.



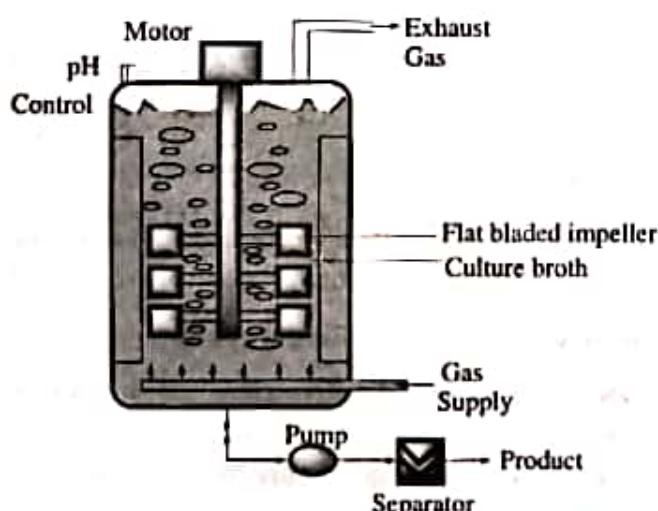
- * PCR Stands for polymerase chain reaction. It is a technique used for gene amplification invitro.
- * Each cycle of PCR has three steps. They are
 - i) Denaturation
 - ii) Primer annealing
 - iii) Extension of primers.
- * High temperature induce denaturation of DNA
- * Two sets of primers, Taq polymerase enzyme and deoxyribonucleotides are added to denatured DNA.
- * Taq polymerase extends the primery using the deoxyribonucleotides.
- * As a result of repetition of this process many times, the segment of DNA can be amplified to approximately billion times.

2. What is a bio-reactor? Describe briefly the stirring type of bio-reactor.

- A. Bio-reacter :** It is the vessel in which raw materials are biologically converted into specific products using microbial plant, animal (or) human cells.

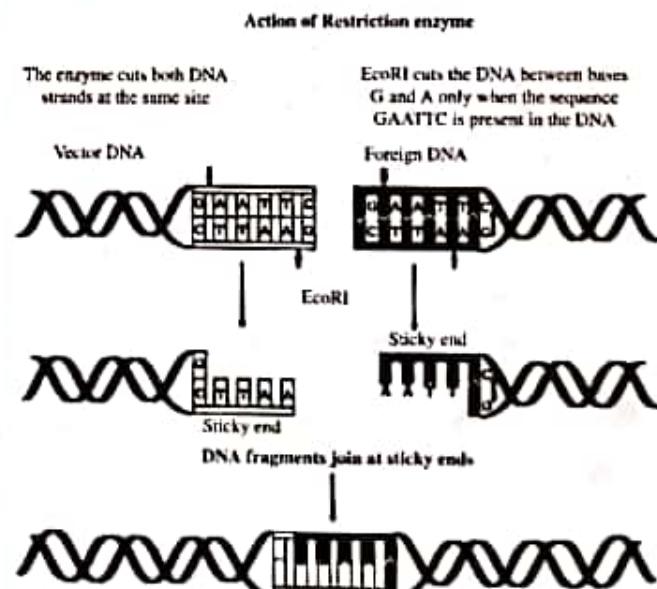
Stirring type of bio-reactor :

- * It is usually cylindrical (or) with a curved base vessel.
- * It has an agitator system, an oxygen delivery system, pH control system and sampling ports.
- * These vessels contains flat bladed stirrer.
- * This stirrer facilitate even mixing and oxygen availability throughout the bio-reactor.



LONG ANSWER QUESTIONS

1. Give a brief account of the tools of recombinant DNA technology.
- A. Tools of recombinant DNA technology are
 - i) Restriction enzymes ii) Polymerase enzymes
 - iii) Ligases iv) Vectors v) The host organism.
- I) **Restriction enzymes :**
- * Restriction endonucleases also called as restriction enzymes. These enzymes cut the long, linear DNA molecule into fragments. These enzymes can recognize a specific nucleotide sequence called **palindrome** sequence. Palindromic sequence is letters that form the same words when read in both forward and backward direction. For example *EcoRI* recognises palindromic sequence 5' GAATTC 3' 3' CTTAAG 5' and cut the DNA between G and A on both strands. This leads to formation of sticky single stranded portion of the ends. This type of cut is **staggered cut**. This stickiness of the ends facilitates the action of the enzyme DNA ligase.



Steps in formation of recombinant DNA by action enzyme - EcoRI of restriction endonuclease

- * These enzymes are isolated from bacteria and named with three (or) four letter sequence followed by roman numerical.
- * Eg : *EcoRI*. Today we know more than 900 restriction enzymes that have been isolated from over 230 strains of bacteria.

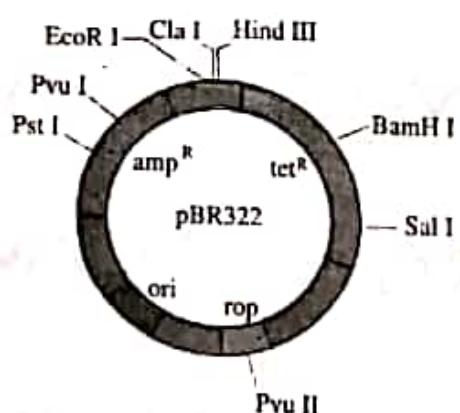
ii) Cloning Vectors :

- * The DNA used as a carrier for transferring a fragment of foreign DNA into a suitable host is called **Vector**.
- * Vector used for multiplying the foreign DNA sequences are called **cloning vectors**.
- * Eg: plasmids, bacteriophages, cosmids and artificial chromosomes etc.

Characteristic features of vector :

- * Should have low molecular weight.
- * Should contain one (or) two selectable markers (genes encoding antibiotic resistance).
- * Should contain origin of replication (ORI).
- * Should contain restriction sites for endonucleases for incorporation of desired genes.
- * Should be easy to isolate and purify.
- * Apart from natural vectors artificial restricted plasmids like p^{BR322} , p^{UC19} , p^{UC101} etc are also used in rDNA technology.

Principles and Processes



- * Ti plasmid of *Agrobacterium tumifaciens* is used to deliver desired gene into plants and disarmed retrovirus are now used to deliver desired genes into animal cells.

iii) Competent Host :

- * To introduce the recombinant DNA into the bacterial cells, they should be made competent to take up DNA.

* This is done by treating them with a specific concentration of calcium ions which increases the efficiency of uptaking of DNA by bacteria through pores of its cell wall.

2. Explain briefly the various processes of recombinant DNA technology?

- A. rDNA technology involves several steps in sequence such as,
- * Isolation of the Genetic material (DNA).
 - * Cutting of DNA at specific Locations.
 - * separation and isolation of desired DNA fragments.
 - * Amplification of Gene of Interest using PCR.
 - * Insertion of isolated gene into a suitable vector.
 - * Insertion of Recombinant DNA into the Host Cell.
 - * Selection of Transformed host cells.
 - * Obtaining the Foreign Gene Product and Downstream Processing.

Isolation of the Genetic material (DNA) :

- * DNA should be isolated in pure form, without other macromolecules. Hence cell wall can be broken by treating the bacterial cells/ plant cells/ animal tissue with enzymes such as Lysozyme (bacteria), cellulase (plant cells) chitinase (fungus)
 - * DNA should be removed from its histones proteins and RNA. This can be achieved by using enzymes ribonuclease for RNA and proteases for histone proteins.
- Finally purified DNA precipitates out after the addition of cold Ethanol.

Cutting of DNA at specific Locations :

- * Restriction enzyme digestions are performed by incubating purified DNA molecules with the restriction enzyme. This process is also applicable to vector.



Separation and isolation of desired DNA fragments :

- * DNA fragments can be separate using Agarose gel electrophoresis.
- * DNA is a negatively charged molecule, hence it moves towards the positive electrode (anode) and are separated based on size.
- * The separated bands of DNA are cut out from the Agarose gel and extracted from the gel piece called elution.

Amplification of Gene of Interest using PCR :

- * PCR stands for polymerase chain Reaction.
- * In this reaction, multiple copies of the gene of interest is synthesized in vitro using two sets of primers and the enzyme DNA polymerase (Taq polymerase).
- * The process of replication of DNA is repeated many times, the segment of DNA can be amplified to approximately billion times.
- * The amplified fragment if desired can now be used to ligate with a vector for further cloning.

Insertion of isolated gene into a suitable vector :

- * The cut out gene of interest from the source DNA and the cut vector with space are mixed and ligase is added.
- * This results in the preparation of recombinant DNA.

Insertion of Recombinant DNA into the Host cell/organism :

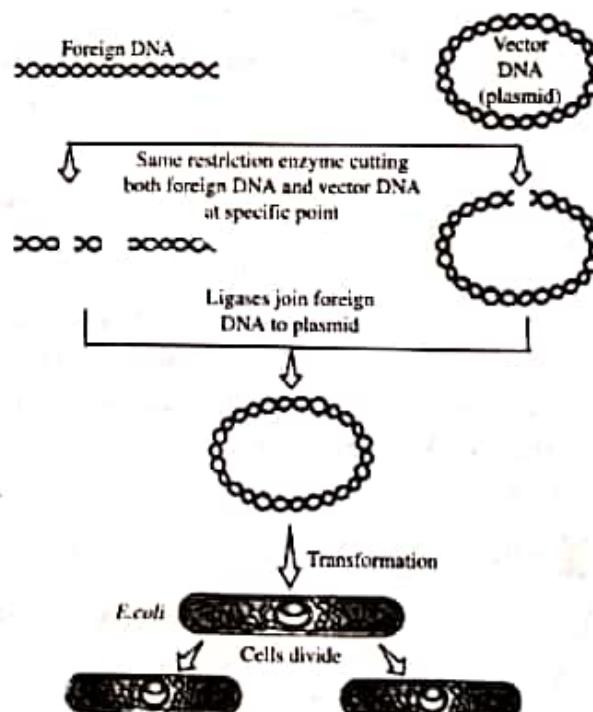
- * There are several ways of introducing the ligated DNA into recipient cells.
- * Eg : Heat shock method - into bacterial cells.
- * Microinjection - into animal cells.
- * Gene gun method - into plant cells.
- * Disarmed pathogen vectors - into plant and animal cells.

Selection of Transformed host cells :

- * If a recombinant DNA bearing gene for resistance to an antibiotic (Eg: ampicillin), if we spread the transformed cells on agar plates containing ampicillin, only transformants will grow, untransformed recipient cells will die. The ampicillin resistance gene in this case is called a selectable marker.

Obtaining the Foreign Gene Product and Downstream Processing :

- * The cells harbouring cloned genes of interest may be grown on a small scale in the laboratory. Large scale production is carried out in Fermentors.
- * The cultures may be used for extracting the desired protein and then purifying it by using different separation techniques.
- * The processes include separation and purification, which are collectively referred to as downstream processing. Strict quality control testing for each product is also required.



12. Biotechnology & its applications

VERY SHORT ANSWER QUESTIONS

- Give different types of cry genes and pests which are controlled by the proteins encoded by these genes.
 A. The proteins of *Cry I Ac* and *Cry II Ab* control cotton bollworms.
 * The proteins of *Cry I Ab* control corn borers.
- What is GEAC and what are its objectives?
 A. GEAC-Genetic Engineering Approval Committee
 * Make decisions regarding the validity of genetic modifications & the safety.
- Name the nematode that infects the roots of tobacco plants. Name the strategy adopted to prevent this infestation.
 A. *Meloidogyne incognita*
 * RNA interference (RNAi).
- Give one example for each of transgenic plants which are suitable for food processing and those with improved nutritional qualities.
 A. Transgenic plant suitable for food processing is "flavr savr" variety of tomato.
 * Transgenic plant with improved nutritional value is Taipei golden rice with Vit-A rich nature.
- What is green revolution? Who is regarded as father of green revolution?
Green revolution- The improvement of yield of crops through conventional and non-conventional breeding methods to meet the requirements of human population across the world called **Green revolution**.
 * N.E.Borlaug.

SHORT ANSWER QUESTIONS

- List out beneficial aspects of transgenic plants
 A. Some of the beneficial aspects are as follows:
 * Bt. Cotton is resistant to insects.

- * Transgenic potato plants resistant to fungus Phytophthora.
- * Transgenic tomato 'Flavr Savr' is bruise resistant suitable for storage and transport due to delayed ripening offers longer shelf-life.
- * Transgenic golden rice obtained from 'Taipei' is rich in vitamin A and prevents blindness.
- * Male sterile plants of *Brassica napus* will eliminate the problem of manual emasculation and reduce the cost of hybrid seeds production.
- 2. What are some biosafety issues concerned with genetically modified crops?
 A. Some of the important biosafety issues concerned with GMO are:
 * There is a risk of altering the fundamental nature of vegetables and fruits.
 * Transfer of allergens or toxic substances into human beings and other animals.
 * A risk of gene pollution due to new gene transfer into related local varieties through natural out crossing results formation of super weeds.
 * Super weeds may become resistant to weedicides.
 * They may bring about changes in natural evolutionary patterns.
- 3. Give a brief account of Bt cotton
 A. The soil bacterium *Bacillus thuringiensis* produces Cry (crystal) proteins are toxic to insect larvae like tobacco bud worm, Beetle etc.
 * Cry proteins exist as inactive protoxins and get converted into active toxin due to the alkaline pH of the gut which solubilises the crystals.
 * The activated toxin creates pores to the epithelial cells of midgut that cause the death of the insect.
 * *Cry I Ac* and *Cry II Ab* control the cotton bollworm.



4. Give brief account of pest resistant plants?

- A. Some nematodes like meloidogyne incognita infect roots of tobacco plant and results in reduced yield.
- * To prevent this infestation mechanism of RNA interference is employed. Nematode specific genes are introduced into the host plant by using Agrobacterium as a vector.
 - * The introduced DNA produces both sense and antisense RNAs within the host cells. These two RNAs combine to form a double stranded RNA (ds RNA) that initiate RNAi and silence the particular mRNA of nematode.

UNIT-VI PLANTS, MICROBES AND HUMAN WELFARE

13. Strategies for Enhancement in Food Production

VERY SHORT ANSWER QUESTIONS

1. What is meant by hidden hunger.

- A. The food supplementation with deficiency of micronutrients, proteins and vitamins is called hidden hunger.

2. Name two semi-dwarf varieties of rice developed in India.

- A. Jaya and Ratna

3. Give two examples of wheat varieties introduced in India. Which are high yielding and disease resistant.

- A. Sonalika and Kalyan Sona

4. Give two examples of fungi used in SCP production

- A. Candida utilis (Torula yeast)

* Saccharomyces cerevisiae (Baker's yeast)

5. Which two species of sugarcane were crossed for better yield?

- A. Saccharum barberi and Saccharum officinarum

6. Define totipotency and explant.

- A. Totipotency : The capacity of plant cell to develop into an entire plant is called totipotency.

* Explant : Any living part of plant taken out and grown in special nutrient medium.

7. Define micropropagation and somaclones

- A. Micropropagation : The production of large number of plants in a very short time and limited space is known as micropropagation.

* Somaclone : Plants grown through tissue culture which are genetically identical with the original plant are called somaclones.

8. What is meant by germplasm collection?

- A. The entire collection of plant /seeds, having all the diverse alleles for all genes in a given crop is called germ plasm collection

9. What is meant by biofertilization.

- A. The process of breeding crops with higher levels of vitamins, minerals, proteins and fat contents is called biofertilization.

* It is employed in improving public health.

10. Which part of the plant is best suited for making virus-free plants and why?

- A. Apical Meristem as the cells are in dividing state.

SHORT ANSWER QUESTIONS

1. Give few examples of biofortified crops. What benefits do they offer to the society?

- A. Atlas 66 - Wheat variety having a high protein content

* Golden Rice- β carotene containing rice variety

* Carrot, Spinach, Pumpkin - Vitamin-A enriched.

* Bittergourd, Tomato - Vitamin-C enriched.

* Bathua, Spinach - Iron & Calcium enriched.

Benefits :

- * It aims at breeding crops with higher levels of vitamins and minerals.
- * Higher protein and healthier fats to improve public health.

2. Write a short note on SCP

- A.** Dried biomass of a single cell species of microbes that can be used as proteins are called single cell protein.
- * Microbes like Algae, Fungi and bacteria are used in ScP production.

S.	Algae	Fungi	Bacteria
No.			
1.	Spirulina maxima	Torula yeast	Brevibacterium
2.	Chlorella pyrenoids	Bakers yeast	Methylophilus
3.	Scenedesmus acutus	Chaetomium cellulolyticum	

- * SCP utilization can reduce environmental pollution.
- * It is possible to produce large amount protein in short period of time.

LONG ANSWER QUESTIONS

- 1. You are a botanist working in the area of plant breeding. Describe the various steps that you will undertake to release a new variety.**

- A.** The main steps in breeding a new genetic variety of a crop are.

i) Collection of Variability :

- * Genetic variability is the root of any breeding programme. Collection and preservation of all different wild varieties, species and relatives of cultivated species is a prerequisite for effective exploitation of natural genes available in the populations.

- * The entire collection having all the diverse alleles for all genes in a given crop is called 'Germplasm collection'.

ii) Evaluation and selection of parents :

- * The germplasm is evaluated so as to identify plants with desirable characters. The selected

plants are multiplied and are used. Pure lines are created whenever desirable and possible.

iii) Cross hybridisation among the selected parents :

- * After emasculation the female flowers are enclosed in a polythene bag to prevent undesired cross pollination. Pollen grains are collected from the male parent with the help of a brush and are transferred to the surface of the stigma and thus cross pollination is affected artificially.

iv) Selection and Testing of Superior recombinants :

- * It involves selecting among the progeny of hybrids, those plants that have the desired character combination. The selection process requires careful scientific evaluation of the progeny. Due to this, plants that are superior to both the parents are obtained. These are self pollinated for several generations till they reach a homozygosity.

v) Testing, release and commercialisation of new characters :

- * The newly selected lines are evaluated for their yield and other traits of quality, disease resistance etc. It is done by growing these in research fields and recording their performance under ideal fertilizer application, irrigation and other crop management practices. It is followed by testing the materials in farmers fields for atleast three growing seasons at several places in the country, in all agronomic zones. Finally they are distributed as a new variety.

- 2. Describe the tissue culture technique and what are the advantages of tissue culture over conventional method of plant breeding in crop improvement programmes?**

- A.** The technique of growing culturing of plants in invitro processs is called tissue culture. It involves the following steps.

i) Preparation of nutrient medium :

- * For the growth of normal plant water & minerals and CO₂, Oxygen all are require.

- * They derive all these nutrients from nature (soil & atmosphere).

* In tissue culture preparation of nutrient culture medium is essential.

* Nutrient culture medium is a mixture of essential nutrients which are mixed in distilled water.

ii) Sterilisation of nutrient medium :

* The nutrient medium is rich in nutrients and therefore attracts the growth of micro organisms.

* The culture medium is autoclaved for 15 min. at 121°C for 15 pounds of pressure.

iii) Preparation of explant :

* Any living part of the plant taken out and grown in special nutrient is called explant.

* After collecting explant sterilization of explant with Sodium hypochlorite and distilled water.

iv) Inoculation of explant :

* The plant cell which is used as seedling material in tissue culture is called explant.

* The transfer of explants on to the sterilized nutrient medium is called inoculation.

v) Incubation for Growth :

* The culture tubes with explant are incubated in a culture room under controlled conditions for 3 to 4 weeks. Then the cells of explant divide & redivide and produce a mass of cells called callus.

* When growth regulator are supplied to this callus it produce shoot and roots and is called organogenesis.

* Some times embryo like structures (embryoids) called somatic embryos are formed from the callus.

vi) Acclimatization of plantlets and transfer to pots :

* The plants produced through tissue culture are planted in pots kept in glass house for 1-2 weeks. Finally they are transferred to field.

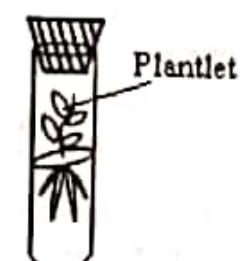
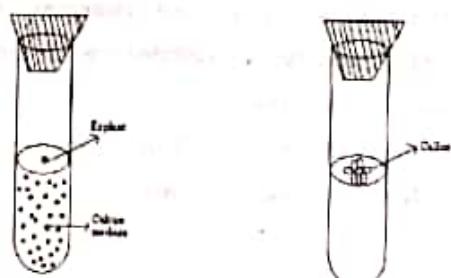
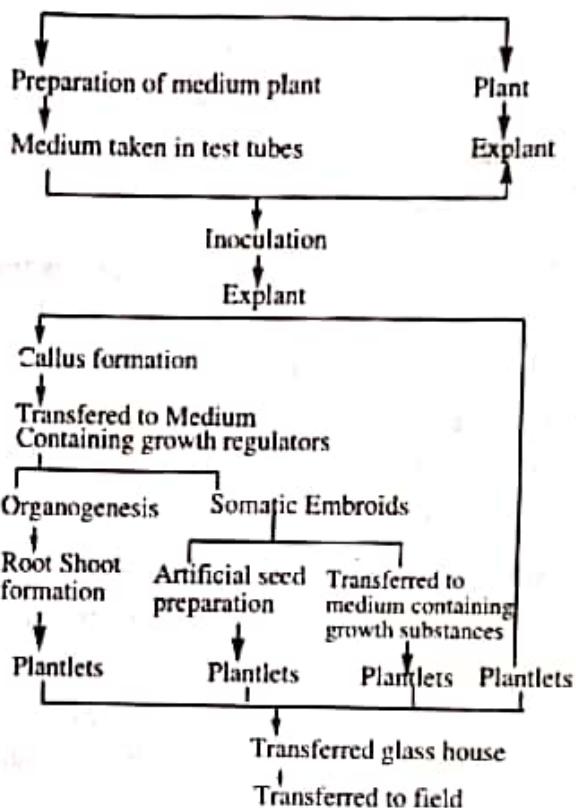
Advantages :

* Through tissue culture it is possible to produce large number of plants within short period of time with in the short space is called micropropagation.

* Plants thus produced are genetically identical to the original plants and hence they are called somaclones.

- * It is useful to produce many economically important plants like Tomato, Banana, Apple, Teak, Eucalyptus, Bamboo etc.....
- * Virus free plant can be produced by meristem culture.

FLOW CHART OF PLANT TISSUE CULTURE



Tissue culture

14. Microbes In Human Welfare

VERY SHORT ANSWER QUESTIONS

1. Why does 'swiss cheese' have big holes. Name the bacteria responsible for it ?

A. The large holes in 'swiss cheese' are due to the production of a large amount of CO_2 obtained through fermentation.

* *Propionibacterium shermanii.*
2. Name a microbe used for statin production. How do statins lower blood cholesterol level?

A. *Monascus purpureus.*

* It inhibit enzyme activity for synthesis of cholesterol by acting as competitive inhibitor to enzyme.
3. Why do we prefer to call secondary waste water treatment as biological treatment?

A. Aerobic microbes degrades organic matter in the primary effluent and reduce BOD during secondary treatment. So it is called biological treatment.
4. Write the most important characteristic that *Aspergillus niger*, *Clostridium butylicum* and *Lactobacillus* share?

A. *Aspergillus Niger*, *Clostridium butylicum* and *Lactobacillus* used for production of organic acids.

* *Aspergillus niger* (Fungus) - Citric acid.

* *Clostridium butylicum* (Bacterium) - Butyric acid.

* *Lactobacillus* (Bacterium) - Lactic acid.
5. Name any two genetically modified crops?

A. Bt - Cotton.

* Bt - Brinjal.

6. Name any two industrially important enzymes?

A. Lipases are used in detergent formulations in removing oily stains from laundry.

* Pectinases and Proteases are used to clarify the bottled juices.
7. Name an immunosuppressive agent? From where it is obtained.

A. Cyclosporin- A.

* *Trichoderma polysporum.*
8. What are fermentors?

A. Large vessels in which microbes are grown in large numbers on an industrial scale called fermentors.
9. What is the group of bacteria found in both the rumen of cattle and sludge of sewage treatment?

A. Methanogens.
10. Name the scientists who were credited for showing the role of penicillin as an antibiotic?

A. * Ernest chain.

* Howard Florey.

SHORT ANSWER QUESTIONS

1. How do mycorrhizal fungi help the plants harbouring them?

A. Mycorrhizae are the fungi living in symbiotic association with the roots of higher vascular plants.

* The fungal symbiont facilitates absorption of phosphorus by the plant from the soil.

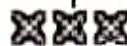
* It develops resistance to root-born pathogens.

* Improve tolerance to salinity and drought.

* Overall increase in plant growth and development.



2. What is the chemical nature of Biogas? Explain the process of biogas production?
- A. Chemically biogas comprises methane (CH_4), CO_2 , traces of H_2S and moisture.
- * Certain bacteria grow anaerobically on cellulosic material produce methane along with CO_2 and H_2 . These bacteria are called Methanogens.
- Process of biogas production :**
- * The biogas plant consists of a concrete tank (10-15 ft deep) in which bio-wastes are collected and slurry of dung is fed.
 - * A floating cover is placed over the slurry and the gas is produced in the tank due to microbial activity & connected to a pipe to supply biogas to nearby houses.
3. What are biofertilizers? Write a brief note on them?
- A. Biofertilisers are organisms that enrich nutrient quality of the soil.
- Eg : Bacteria : Rhizobium, Azotobacter.
- * Fungi : Glomus.
- * Cyanobacteria : Nostoc, Anabaena.
- * Rhizobium is the bacterium found in the root nodules of leguminous plants with symbiotic association.
- * Azospirillum and Azotobacter (free-living bacteria) fix atmospheric nitrogen.
- * Nostoc, Anabaena are autotrophic microbes can fix atmospheric nitrogen in paddy fields,



IA - Digestion and Absorption

VERY SHORT ANSWER QUESTIONS

1. Give the dental formula of adult human being.
A. Dental formula of adult human being is
$$\begin{array}{c} 2.1.2.3 \\ \text{---} \\ 2.1.2.3 \end{array} = 32$$
2. Bile juice contains no digestive enzymes, yet it is important for digestion. How?
A. Bile salts in bile juice help in emulsification of fats
(Break down of fats into very small micelles)
3. What would happen, if HCl were not secreted in the stomach?
A. Pepsinogen cannot be activated in the absence of HCl and proteins are not digested in stomach.
4. What is autocatalysis? Give two examples?
A. An enzyme activates its own inactive enzyme.
Eg: Trypsin, Pepsin
Active trypsin converts inactive trypsinogen into active trypsin.
5. What is chyme?
It is the partially digested food formed by the action of gastric juice in the stomach.
6. Name the salivary glands and their location in human
A. i. Parotid glands - below ear pinna
ii. Submaxillary glands - angles of lower jaw
iii. Sub lingual glands - below the tongue
7. Name the types of papillae on human tongue.
A. 1. Fungiform
2. Filiform and
3. Circumvallate papillae
8. What is the hardest substance in human body?
What is its origin?
A. Enamel is the hardest substance.
It is ectodermal in origin.

9. Name the two hormones secreted by the duodenal mucosa.

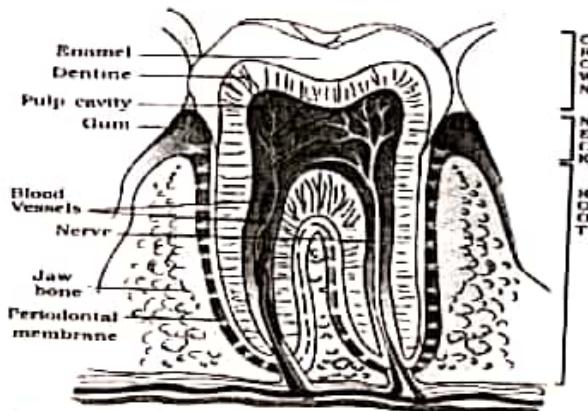
- A. 1. Secretin 2. Cholecystokinin

10. Name the structure of gut which is vestigial in human being, but well developed in the herbivore. Mention the type of tissue in it.

- A. It is vermiform appendix. It has lymphoid tissue.

SHORT ANSWER QUESTIONS

1. Draw a neat labeled diagram of L.S of tooth?



2. Describe the process of digestion of proteins in stomach.

- A. Gastric juice has two inactive enzymes namely pepsinogen and prorennin.
HCl converts inactive pepsinogen into active pepsin. It digests proteins
- * $\text{Pepsinogen} \xrightarrow{\text{HCl}} \text{pepsin} \xrightarrow{\text{pepsin}} \text{proteins}$
 - * $\text{Proteins} \xrightarrow{\text{Pepsin}} \text{proteoses + peptones} \xrightarrow{\text{peptones}} \text{peptides}$
 - * HCl converts inactive prorennin into active rennin
 - * $\text{Prorennin} \xrightarrow{\text{HCl}} \text{rennin}$
 - * Rennin converts milk protein casein into calciumparacaseinate in the presence of Ca^{2+}
 - * $\text{Casein} \xrightarrow[\text{Ca}^{2+}]{\text{Rennin}} \text{calcium para caseinate}$
 - * Pepsin converts calciumparacaseinate into peptides

3. Explain the role of pancreatic juice in the digestion of proteins.

A. Pancreatic juice contains the proteins digesting enzymes namely trypsinogen, chymotrypsinogen and carboxypeptidase.

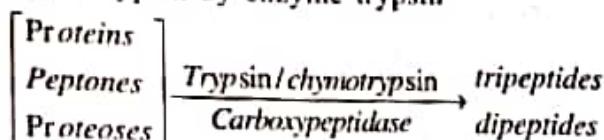
* Inactive trypsinogen is converted into trypsin by enzyme enterokinase

* Trypsinogen $\xrightarrow{\text{Enterokinase}}$ trypsin

* Trypsinogen $\xrightarrow{\text{Trypsin}}$ Trypsin

(Autocatalysis)

* Inactive chymotrypsinogen is converted into chymotrypsin by enzyme trypsin



4. What are the functions of liver?

A. Liver performs functions like synthesis, storage and secretion

* Bile juice is used for emulsification of fats.

* It plays key role in carbohydrate metabolism. (glycogenesis and glycogenolysis).

* Synthesises plasma proteins

* Synthesises urea by Ornithine cycle.

* Conversion of lactic acid into glycogen (Cori cycle)

* Detoxification of toxic substances.

* Haemopoietic organ in the foetus.

* It acts ~~as the main digestive organ~~.
The main respiratory organ.

IB - Breathing and Exchange of Gases

VERY SHORT ANSWER QUESTIONS

1. Define vital capacity. What is its significance?

A. It is the maximum volume of air a person can breath in after forced expiration

$$VC = TV + IRV + ERV$$

It helps in analysing lung function.

2. What is the effect of P_{CO_2} on oxygen transport?

A. Increase in P_{CO_2} reduces the affinity of hemoglobin for oxygen.

3. What is tidal volume? Find out tidal volume in a healthy man, in an hour.

A. It is volume of air inspired or expired during normal breathing. It is 6 to 8 litres per minute.

$$6 \text{ to } 8 \times 60 = 360 \text{ to } 480 \text{ litres per hour.}$$

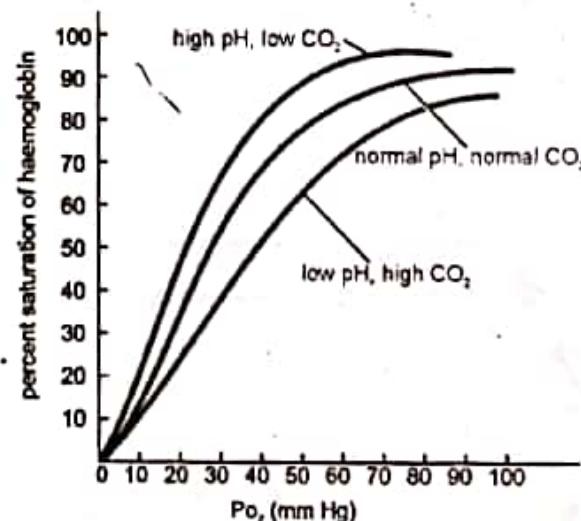
4. What are conchae?

A. They are the twisted bony plates of nasal chamber

5. What is chloride shift?

A. It is the exchange of chloride and bicarbonate ions between RBC and plasma at the tissues.

6. Draw a diagram of oxyhemoglobin dissociation curve.



SHORT ANSWER QUESTIONS

1. Explain the process of inspiration and expiration under normal conditions.

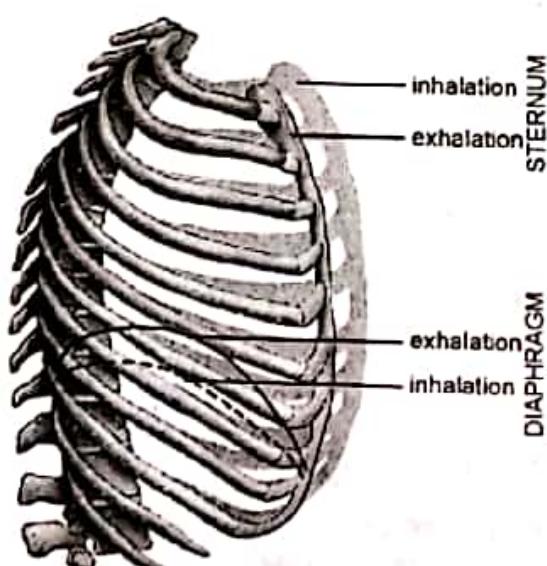
A. Breathing involves two stages - inspiration and expiration

Inspiration :

- * In take of atmospheric air into the lungs.
- * It is an active process, as the muscles contract.
- * The diaphragm becomes flat due to contraction of its muscles.
- * The contraction of external intercostal muscle lifts up the ribs and sternum.
- * This increases the volume of the thoracic chamber.
- * It causes increase in the pulmonary volume.
- * It forces the air from the outside to move into the lungs.

Expiration :

- * Release of alveolar air to the exterior.
- * It is a passive process.
- * Relaxation of the diaphragm and external intercostal muscles, returns the diaphragm and sternum to their normal position.
- * It reduces the thoracic volume and thereby the pulmonary volume.
- * This leads to an increase in the intrapulmonary pressure causing the expulsion of air from lungs.



2. What are the major transport mechanisms for CO_2 ? Explain.

- A. CO_2 is transported in three ways

In dissolved state :

- * 7% of CO_2 is carried in dissolved state through plasma $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$

As carbamino compounds :

- * About 20-25% of CO_2 combines directly with free amino group of haemoglobin and forms carbamino-hemoglobin.
- * $\text{Hb}-\text{NH}_2 + \text{CO}_2 \rightarrow \text{Hb}-\text{NHCOO}^- + \text{H}^+$

As Bicarbonates :

- * About 70% of CO_2 is transported as bicarbonate.
- * RBCs contain a very high concentration of the enzyme, carbonic anhydrase. It catalyses the following reactions.
 - * $\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{Carbonic anhydrase}} \text{H}_2\text{CO}_3$
 - * $\text{H}_2\text{CO}_3 \xrightarrow{\text{Carbonic anhydrase}} \text{HCO}_3^- + \text{H}^+$

Chloride shift :

- * The bicarbonate ions from RBC enter into plasma and chloride ions of plasma enter into RBC. ** every 100 mL of deoxygenated blood contains approximately 20 mL of CO₂ by volume.*
- 3. How is respiratory movements regulated in man?

Respiratory rhythm centre :-

- * Present in the medulla region of brain primarily responsible for respiration rhythm.

Pneumotaxic centre :

- * Present in the Pons of the brain can moderate the functions of respiratory rhythm centre.

Chemo-sensitive area :

- * Highly sensitive to CO_2 and hydrogen ions.
- * If these increase, it sends signals to respiratory rhythm center helps in elimination of these substances.

Aortic arch and carotid artery :

- * Chemoreceptors recognize changes in CO_2 and H^+ concentration and send signals to respiratory rhythm center and pneumotaxic centre for necessary action.

4) Describe disorders of respiratory system.

- A. **Asthma** : A type of allergy due to inflammation of bronchi and bronchioles.
- * **Symptoms** : Coughing, difficulty in breathing, wheezing, constriction of bronchi.
- * **Emphysema** : Caused by smoking of tobacco
- * **Symptoms** : Alveolar walls are damaged and coalesce, exchange of gases decreases.
- * **Bronchitis** : Increase mucus production and decrease in the diameter of bronchi.
- * **Symptoms** : Chronic cough with thick mucus.

- * **Pneumonia** : Caused by *Streptococcus pneumonia*, virus, fungi and protozoan.
- * **Symptoms** : Inflammation of lungs, accumulation of mucus in alveoli.
- Occupational respiratory disorders :**
- * **Asbestosis** : It is caused due to asbestos.
- * **Silicosis** : Caused by exposure to silica dust.
- * **Siderosis** : Caused due to deposition of inhaled iron particles.
- * **Black - lung disease** : Caused by inhalation of coal dust.

UNIT-II HUMAN ANATOMY AND PHYSIOLOGY - II

IIA - Body Fluids and Circulation

VERY SHORT ANSWER QUESTIONS

1. Write the differences between open and closed system of circulation.

A. **Open circulation** : In this type the blood flows from vessels into open spaces called sinuses.
Eg : Arthropoda.

Closed circulation : In this type blood flows through blood vessels.

Eg : Vertebrates

2. Sino-atrial node is called the pace maker of our heart why?

A. It has the ability to generate action potentials without any external stimuli.

3. What is the significance of AV node and AV bundle in the functioning of heart?

A. AV node is a relay point. It conducts the action potentials from SA node to the ventricle muscles through AV bundle.

4. Why are arteries more elastic than the veins?

A. Arteries have two elastic lamina, whereas veins are with one elastic lamina.

SHORT ANSWER QUESTIONS

1. Explain the mechanism of clotting of blood.

A. **Mechanism of Blood Clotting :**

* Clotting takes place in three steps

Step-1:

* Formation of prothrombin activator by two pathways

* Intrinsic path way from damaged blood vessels.

* Extrinsic path way from damaged tissues.

Step-2:

* In the presence of prothrombin activator and Ca^{++} ion, inactive prothrombin converted into active thrombin.

* Prothrombin $\xrightarrow{\text{Prothrombin activator}}$ Thrombin.

Step-3:

* In the presence of thrombin, soluble protein fibrinogen is converted into soluble fibrin, which is converted into insoluble fibrin by Factor XIII [Fibrin Stabilizing Factor].

* Fibrinogen $\xrightarrow{\text{Thrombin}}$ Fibrin.

2. Distinguish between arteries and veins.

Arteries	Veins
Arteries carry oxygenated blood (except pulmonary arteries).	Veins carry deoxygenated blood (except pulmonary veins).
Deeper in the body	Superficial
Thick walled	Thin walled
Lumen is narrow	Lumen is wide
Non-valvular	Valvular
Blood flows with more pressure.	Blood flows with low pressure.

LONG ANSWER QUESTIONS

1. Describe the structure of heart of the man with the help of neat labeled diagram.

A. The heart is mesodermal in origin, situated in the mediastinum.

Pericardium :

- * It is a protective layer with outer fibrous pericardium and the inner serous pericardium.
- * The serous pericardium is double layered formed of an outer parietal layer and inner visceral layer with pericardial fluid.
- * The wall of the heart consists of three layers.
- * Outer epicardium
- * Middle myocardium
- * Inner endocardium

Structure of the heart :

- * Heart is divided into 4 chambers, two atria and two ventricles.

Atria :

- * These are thin walled, blood receiving chambers.
- * Right atrium is larger than the left atrium.
- * These are separated internally by thin interatrial septum.
- * Right atrium receives deoxygenated blood from different parts of body through two caval veins, precaval vein and postcaval vein.
- * The opening of pre-caval vein has no valve.
- * The opening of coronary sinus into the right atrium is guarded by valve of Thebesius.
- * Left atrium receives oxygenated blood from each lung through two pulmonary veins.

- * The left and right atrioventricular apertures are guarded by bicuspid(mitral valve) and tricuspid valves respectively.

Ventricles :

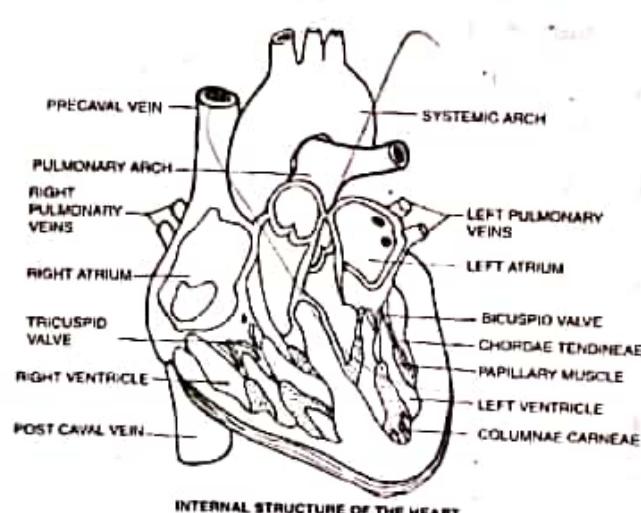
- * These are thick walled blood "pumping chambers" which are separated by an interventricular septum.
- * Muscular ridges of inner surface are called columnae carneae.
- * Some large and conical ridges called papillary muscles are connected to the tricuspid and bicuspid valves by chordae tendineae or heart strings.

Nodal tissue :

- * Sino-atrial node(SAN) present in the right atrium near the opening of the superior vena cavae.
- * Atrio-ventricular node(AVN) is seen in the lower left corner of the right atrium.
- * AVN gives off AV bundle, which divides into bundle branches further divided into Purkinje fibres.

Aortic arches :

- * There are two aortic arches in man.
- * Pulmonary arch : It arises from the right ventricle.
- * Systemic arch (left) : It arises from the left ventricle.
- * The openings of both arches are guarded by pulmonary and aortic valves.
- * Ligamentum arteriosum : is present at the point of contact of the systemic and pulmonary arches.



INTERNAL STRUCTURE OF THE HEART

2. Write notes on working of the heart of man.
- A. Working of heart includes the following.
1. Generation and conduction of action potentials.
 2. Cardiac cycle. 3. Double circulation.
- I. **Generation and conduction of action potentials :**
- * Sino-atrial node(SAN) generates action potential carried towards atrio-ventricular node(AVN). AVN spreads it to ventricular muscles through Purkinje fibres.
2. **Cardiac Cycle :**
- * It consists of 3 phases.
 - i) Atrial systole ii) Ventricular systole
 - iii) Cardiac diastole
- i. **Atrial systole :**
- * The SAN generates an action potential which stimulates both the atria to contract.
 - * 30% of blood flows into ventricle during atrial systole.
- ii. **Ventricular Systole :**
- * Action potentials are conducted through AVN, bundle of his to Purkinje fibres and ventricular muscles.
 - * Ventricular contraction increases the pressure causing the closure of AV valves.
 - * It results in the production of first heart sound known as 'Lub'.
 - * Semilunar valves open and blood in ventricles flows into aortic arches.
- iii. **Cardiac Diastole :**
- * The ventricles now relax and the ventricular pressure falls causing the closure of the semi lunlar valves.
 - * This results in the production of second heart sound 'Duh'.

* All the heart chambers are now in relaxed state. AV valves open and 70% of ventricular filling occurs.

Stroke Volume :

* The volume of blood pumped out by each ventricle for each heart beat is 70ml.

Cardiac Output :

* The volume of blood pumped out by heart from each ventricle per minute.

* Cardiac output = Stroke volume × No. of beats per minute.

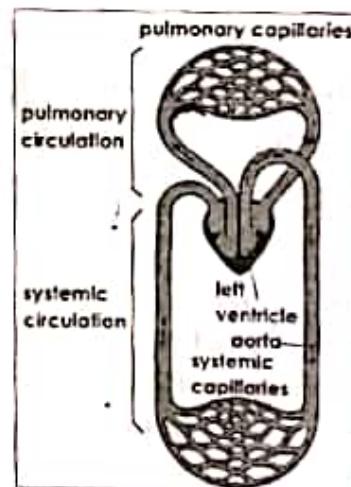
* $70\text{ml} \times 72\text{beats} = 5040\text{ml/min. or 5 litres.}$

3. Double circulation :

* Blood passes through the heart twice in two complete separate circulatory pathways called pulmonary and systemic circulations.

* **Pulmonary circulation :** Deoxygenated blood from heart goes to lungs for oxygenation.

* **Systemic circulation :** It carries O_2 and nutrients from heart to body parts.



IIB - Excretory products and their Elimination

VERY SHORT ANSWER QUESTIONS

1. What are columns of Bertin ?
- A. The renal pyramids are separated by projections of cortex called columns of Bertin.
2. Distinguish between cortical and juxta medullary nephrons.

A. Cortical nephrons :

i) Loop of Henle is short

ii) Vasarecta is absent or reduced.

Juxta medullary nephrons :

i) Loop of Henle is very long

ii) Vasarecta is well developed

3. Define glomerular filtration.

- A. It is the filtration of blood from the glomerulus into Bowman's capsule

4. What is juxtaglomerular apparatus?

- A. The JG cells of afferent arteriole and macula densa of DCT together form the JG apparatus.

5. Distinguish between the enzymes renin and rennin.

- A. **Renin :** It is produced by JG cells. It plays a role in RAAS.

Rennin : It is found in gastric juice of infants. It digests milk proteins.

6. Define glomerular filtration rate.

- A. It is the amount of filtrate formed by both the kidneys per minute. It is 125ml/minute

7. What is osmoregulation?

- A. It is the maintenance of water and solutes balance.

8. What is the role of atrial natriuretic peptide in the regulation of urine formation?

- A. It decreases blood pressure and inhibits RAAS.

SHORT ANSWER QUESTIONS

1. Differentiate vertebrates on the basis of nitrogenous waste products they excrete giving examples?

- A. These are 3 types :

1. Ammonotelic vertebrates: The chief nitrogenous waste material is ammonia.

* Highly toxic and readily soluble in water.

* Eg : Bony fishes, larval forms of amphibians.

2. Ureotelic vertebrates : The chief nitrogenous waste material is urea.

* Urea is produced in liver by ornithine cycle.

* It is 1,00,000 times less toxic than ammonia.

Eg : Cartilage fishes, amphibians and mammals.

3. Uricotelic vertebrates: The chief nitrogenous material is uric acid.

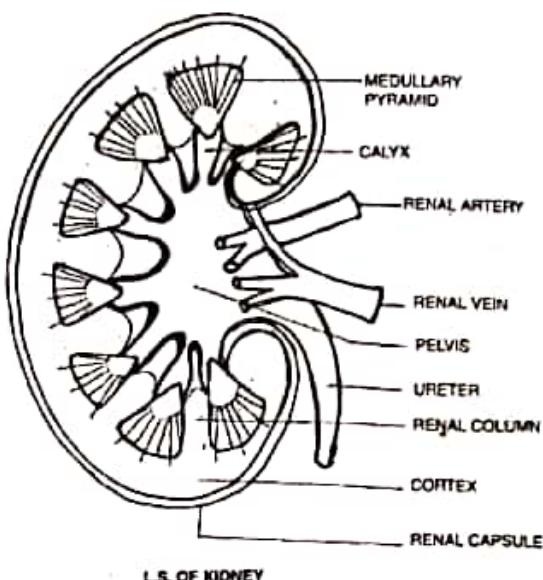
* It is mainly formed from ammonia mostly in liver.

* It is less toxic than urea, insoluble in water and excreted in the form of semi-solid paste or pellets.

Eg : Reptiles and birds.

2. Draw a labeled diagram of the L.S of kidney

A.



LONG ANSWER QUESTIONS

1. Describe the excretory system of man, giving the structure of nephron.

- A. In humans, the excretory system consists of a pair of kidneys, a pair of ureters, a urinary bladder and urethra.

Kidneys :

* Kidneys are located in the abdominal region which are situated on either side of the vertebral column.

* They are reddish brown, bean shaped and retroperitoneal organs.

* Kidneys are enclosed in tough fibrous renal capsule.

* Kidney shows outer cortex & inner medullary regions.

* Medulla is divided into multiple cone shaped renal pyramids which are separated by columns of Bertin.

* The funnel shaped cavity pelvis opens into ureter.

Ureters :

* Slender whitish tubes run posteriorly and open into urinary bladder.

Urinary Bladder :

* It is median storage sac situated in the lower abdominal cavity.

- * The neck of the bladder leads into the urethra, which has internal and external urethral sphincters.

Structure of nephron :

- * Structural and functional unit of kidney, each kidney contains nearly 1 million nephrons.
- * Each nephron has 2 parts, Malpighian body and renal tubule.
- * Renal corpuscle composed of network of blood capillaries called glomerulus and a doubled walled cup called Bowman's capsule present in cortex.

Bowman's capsule :

- * Its inner wall has certain unique cells called **podocytes** which leave minute spaces called **filtration slits or slit pores**.
- * The endothelial cells of the capillaries have numerous pores or **fenestrations**.

Renal tubule :

- * It includes 3 segments.
 - i) PCT (Proximal convoluted tubule).
 - ii) Henle's Loop.
 - iii) DCT (Distal convoluted tubule).

i. PCT :

- * Present in cortex which is wide and highly coiled, which continues into descending limb of loop of Henle. It is lined by cuboidal cells with brush border.

ii. Loop of Henle :

- * It is present in medulla, which is hair pin shaped.
- * It has descending and ascending limbs.
- * Proximal part of ascending limb is thin and distal part is thick which continues into DCT.

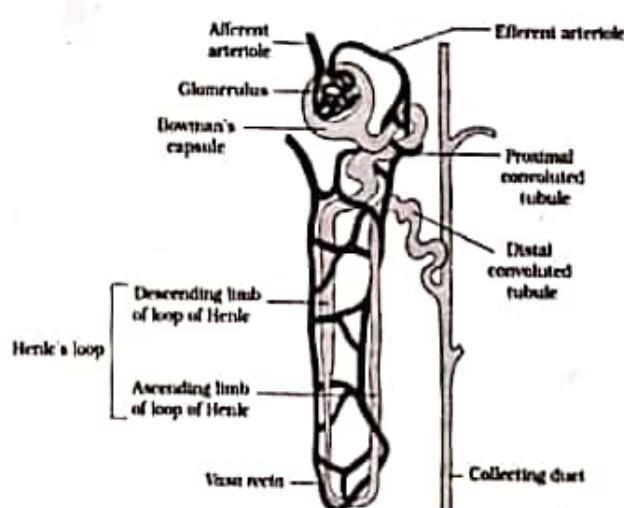
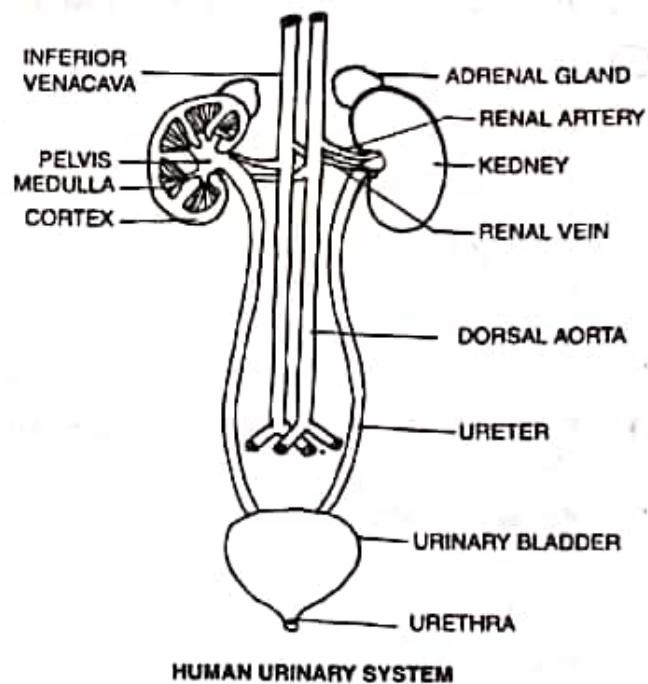
iii. DCT :

- * It is present in cortex, which continues as the '**initial collecting duct**' in the cortex.
- * Initial collecting ducts unite to form **straight collecting duct (CD)**, which passes through medullary pyramid.

Types of Nephrons :

There are two types.

1. Cortical Nephrons
2. Juxtamedullary Nephrons



Nephron

UNIT-III HUMAN ANATOMY AND PHYSIOLOGY - III

III A - Musculoskeletal System

THE MUSCLE

VERY SHORT ANSWER QUESTIONS

1. What is triad system ?
 - A. The T-tubule and the terminal cisternae of sarcoplasmic reticulum on either side form triad system.

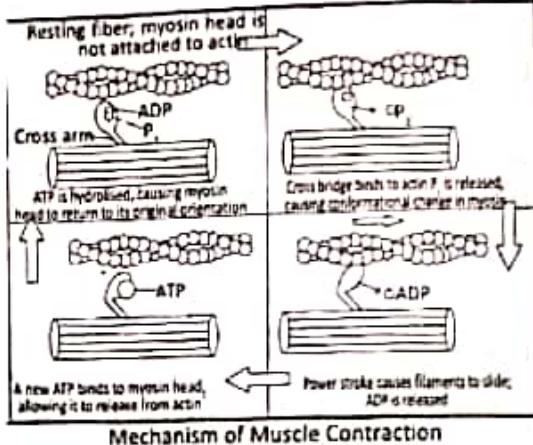
2. What is motor unit with reference to muscle and nerve ?
 - A. A motor neuron and the set of muscle fibres innervated by the telodendrites is the motor unit.

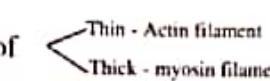
3. Distinguish between red muscle fibres and white muscle fibres.
 - A. *Red muscle fibres :*
 - i) Myoglobin is high
 - ii) Mitochondria are more
 - White muscle fibres:*
 - i) Myoglobin is less
 - ii) Mitochondria are few.

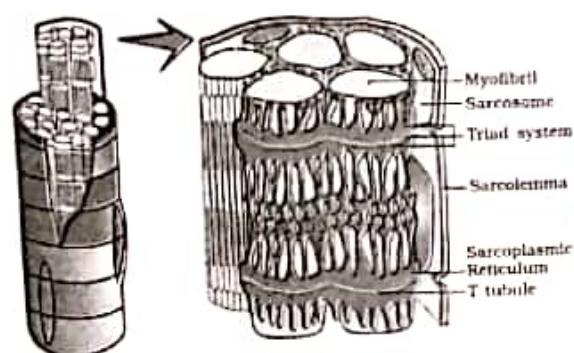
SHORT ANSWER QUESTIONS

1. Describe the important steps in muscle contraction.
 - A. The process of muscle contraction involves various steps.
 - * **Excitation of muscle :** A neurotransmitter acetyl choline is released and it generates action potential in sarcolemma. Sarcoplasmic reticulum releases Ca^{++} ions.
 - * **Formation of cross bridges :** The head of myosin binds to active sites on actin filaments and form cross bridges
 - * **Power Stroke :** Myosin filaments pull the actin filaments towards the centre of A band. It is called power stroke.
 - * **Recovery Stroke :** A new ATP molecule binds to the head of myosin.

- * The cross bridges break and myosin head hydrolyses ATP. This cycle is repeated.



2. Describe the structure of a skeletal muscle.
 - A. Skeletal muscle made of no. of muscle bundles or fascicles. Fasciles covered by perimysium.
 - * Group of fascicles covered by epimysium. Each fascicle is consisting of no. of muscle fibres. Each muscle fibre covered by endomysium.
 - * Each muscle fibre shows sacrolemma, sarcoplasm, sarcoplasmic reticulum, myoglobin, myofibrils etc.
 - * Each myofibril made of 
 - * Each myofibril shows alternate dark & light bands.
 - * Sarcomere consists of a middle complete A-band and 2 half I bands on either side of it.



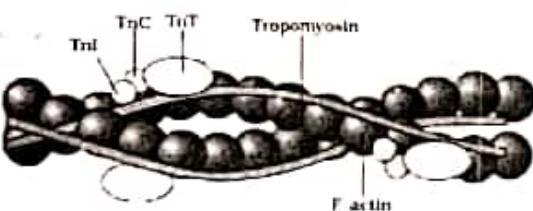
SKELETON

VERY SHORT ANSWER QUESTIONS

1. Name the key stone bone of cranium. where is it located.
A. It is the sphenoid bone. It is located at the middle part of base of skull.
2. Human skull is dicondylic skull. Give the reason.
A. Human skull has two occipital condyles.
3. Name the ear ossicles and their evolutionary origin in human.
A. Middle ear has 3 ear ossicles
i) Malleus - modified articular
ii) Incus - modified quadrate
iii) Stapes - modified hyomandibula
4. Name the type of joint between
a) Atlas/Axis
b) Carpal/Meta carpal of human thumb.
A. a. Atlas and axis - pivot joint
b. Carpal and metacarpal - saddle joint.

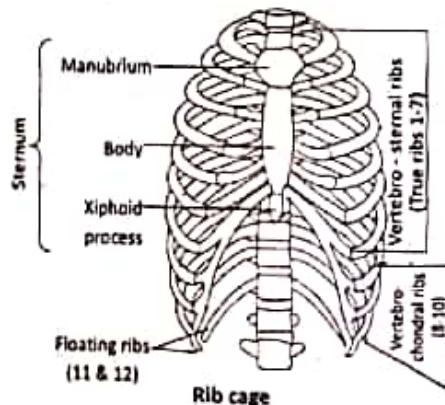
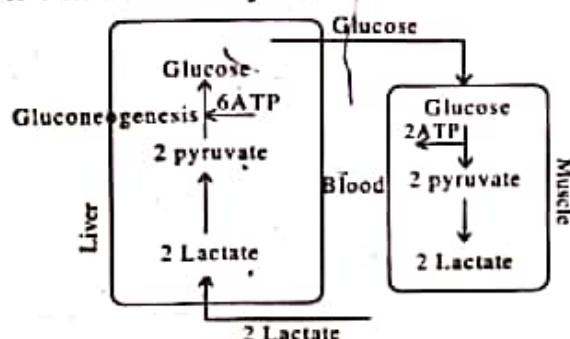
SHORT ANSWER QUESTIONS

1. Write short notes on the ribs of human being.
A. Twelve pairs of ribs, categorised into true ribs and false ribs.
* **True ribs** : 1-7 pairs - vertebro-sternal ribs.
* They connect sternum and vertebral column.
* **False ribs** : 8-10 pairs - vertebro-chondral ribs.
* They connect to cartilaginous part of 7th rib.
11th, 12th pairs are floating ribs they are not connected to sternum.



Thin Filament

- Q) What is Cori's cycle ? Explain the process.
- A. Accumulation of lactic acid occurs due to anaerobic breakdown of glucose in muscle.
 - * The lactic acid is carried to liver through blood circulation.
 - * In liver, lactic (lactate) acid is converted first into pyruvic acid (pyruvate) and then to glucose through gluconeogenesis.
 - * Glucose reaches the muscle.
 - * This two way traffic between muscle and liver is termed as Coricycle.

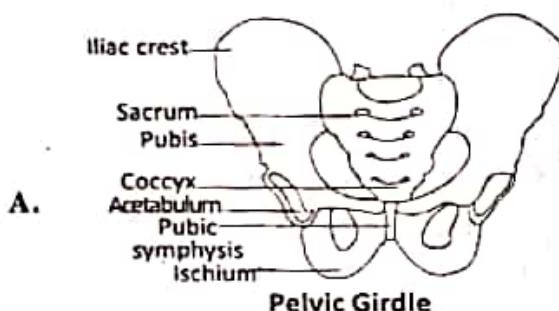


2. List out the bones of human cranium.

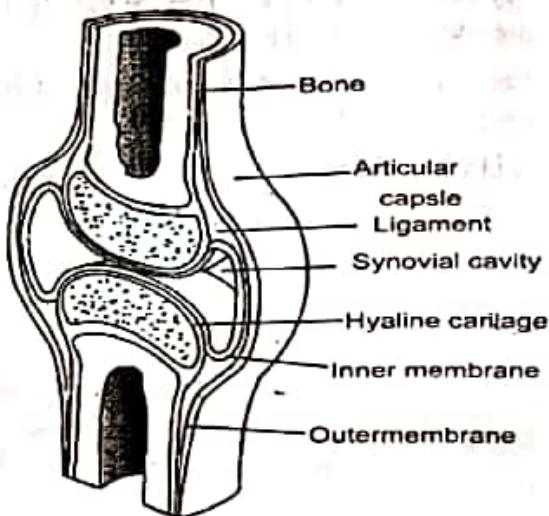
A. Cranium is formed by eight bones.

- * Frontal bone (1)
- * Parietal bones (2)
- * Temporal bones (2)
- * Occipital bone (1)
- * Sphenoid bone (1) → It is key stone bone.
- * Ethmoid bone (1)

3. Draw a neat labelled diagram of pelvic girdle of man.



- * Synovial joint is covered by synovial capsule
- * Synovial capsule has outer layer of fibrous connective tissue.
- * Inner layer of areolar connective tissue and a synovial membrane
- * Synovial membrane secretes synovial fluid into the synovial cavity.
- * It acts as lubricant.
- * Each bone is covered by hyaline cartilage called articular cartilage.



4. Describe the structure of synovial joint with the help of neat labelled diagram.

A. **Synovial Joint :**

- * It is movable joint between two bones

IIIB - Neural control and Co-ordination

VERY SHORT ANSWER QUESTIONS

1. Name the cranial meninges of brain of man.

- A. a. Duramater (outer)
b. Arachnoid (middle)
c. Piamater (inner)

2. What is corpus callosum?

A. It is the transverse bundle of myelinated fibres connecting the two cerebral hemispheres.

3. What is all-or-none principle?

A. The nerve impulse is either conducted totally or not conducted at all. This is called all-or-none principle.

4. What is organ of Corti?

A. It is the group of hair cells on the basilar membrane of cochlea which act as auditory receptors.

5. How do rods and cones of human eye differ from each other chemically and functionally?

A. **Rods :**

- * i) They have rhodopsin
- * ii) Scotopic vision (dimlight vision)

Cones :

- * i) They have iodopsin
- * ii) Photopic vision and colour vision.

6. Distinguish between blind spot and yellow spot.

A. **Blind Spot :**

- * It has no rods and cones. Optic nerve leaves the eye ball.

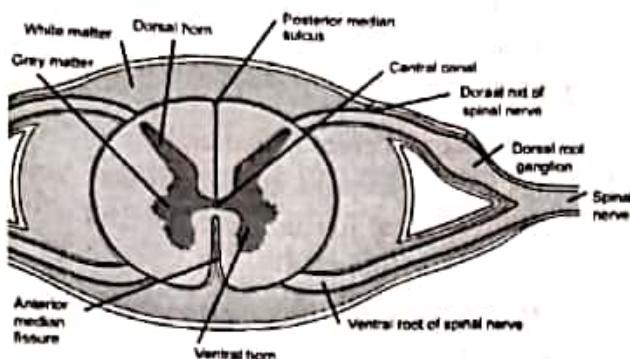
Yellow Spot :

- * It has cones only. It is the area of sharp vision.

SHORT ANSWER QUESTIONS

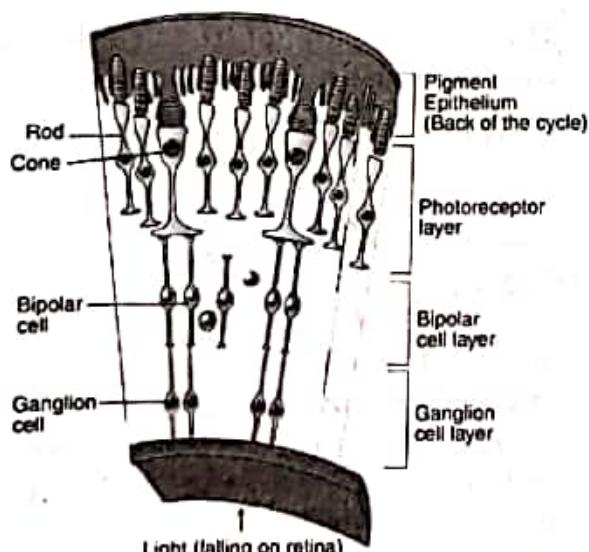
1. Draw a labelled diagram of the T.S. of spinal cord of man?

A.



2. Give an account of the retina of human eye.

- A. Retina is the inner coat of the eye. It consists of
- i) pigmented epithelium
 - ii) neural portion.
- * Neural portion has 3 layers
- i. **Photoreceptor layer :**
- * It consists of rods and cones.
 - * Rods contain rhodopsin and are concerned with dimlight vision.
 - * Cones contain iodopsin and are important in daylight vision and color vision.



- * The centre of the posterior portion of the retina is called yellowspot. It has a depression called Fovea centralis with only cones. It helps in sharp vision.

- * The region of retina with out rods and cones is known as blind spot.

ii. Bipolar cell layer :

- * Consists of bipolar neurons.

iii. Ganglionic cell layer :

- * Ganglionic cell axons extend as optic nerve.

3. Given an account of synaptic transmission.

- A. Synapse is the junction between 2 neurons through which nerve impulse is transmitted. There are 2 types of synapses.

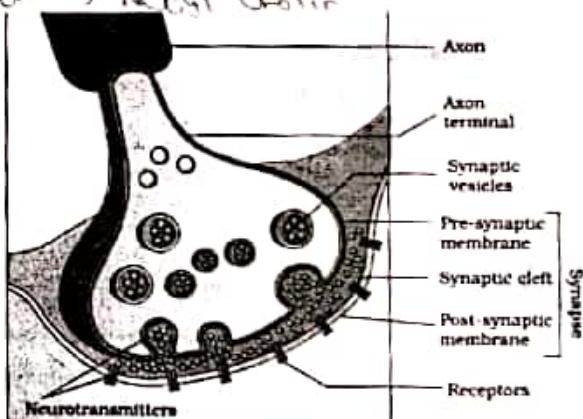
- * **Electrical synapses :** These synapses are very close and also called "gap Junctions". Impulse transmission is faster.

- * **Chemical synapses :** Membranes of pre and post synaptic neurons are separated by synaptic cleft. When impulse reaches the axon terminal, voltage gated calcium channels open.

- * Calcium ions stimulate the release of neurotransmitters from synaptic vesicles.

- * Neurotransmitters bind to ligand gated channels. It causes post synaptic potentials.

→ The most commonly released neurotransmitter is Acetyl Choline



→ The post synaptic membrane has ligand gated channels to respond to chemical signals.

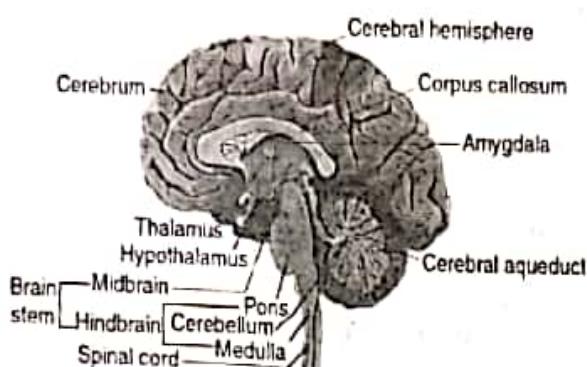
LONG ANSWER QUESTIONS

1. Give a brief account of the structure and functions of the brain of man.

- A. Brain is the site of information processing and control.

- * It is protected in the cranial cavity and covered by 3 cranial meninges.

- * They are outer duramater, middle arachnoid membrane and inner piamater.
- * Sub arachnoid space is filled with cerebro spinal fluid (CSF)
- * It is divided into 3 parts.
i) Fore brain, ii) Mid brain, iii) Hind brain



1. FORE BRAIN : It consists of

- i) Olfactory bulbs concerned with smell
- ii) Cerebrum : It forms the major part of the brain. It is divided into 2 hemispheres and are joined by corpus callosum.
- Outer portion is cerebral cortex that shows gyri and sulci and inner cerebral medulla.
- Each hemisphere consists of 4 lobes namely frontal, parietal, temporal and occipital lobes.
- Cerebral cortex contain 3 functional areas -Sensory area, motor area and association areas (memory and communications.)

iii) Diencephalon : It contains 3 parts Epithalamus, Thalamus and Hypothalamus

- * Epithalamus has anterior choroid plexus and pineal gland.
- * Hypothalamus has pituitary gland. It controls and integrates the activities of the ANS.

2. MID BRAIN :

- * It consists of cerebral peduncles and 4 optic lobes called corpora quadrigemina. Superior colliculi – visual function and inferior colliculi – auditory function.

3. HIND BRAIN : It comprises of cerebellum, pons Varolii and medulla oblongata.

- * i) **Cerebellum** is the 2nd largest part of the brain. It consists of 2 cerebellar hemispheres and a central vermis. It has a branching tree like white matter called arbor vitae. It is the gyroscope of the body.
- ii) **Pons Varolii** : It forms bridge between 2 cerebellar hemispheres and has pneumotaxic centre
- iii) **Medulla Oblongata** : It is the posterior part of brain and continuous with spinal cord below. It has posterior choroid plexus which secretes CSF into cavities of brain. It has cardiovascular and respiratory centres.
- The midbrain, pons and medulla oblongata are collectively referred to as brain stem.

UNIT-IV HUMAN ANATOMY AND PHYSIOLOGY - IV

IVA - Endocrine System

VERY SHORT ANSWER QUESTIONS

1. What is acromegaly ? Name the hormone responsible for it.
- A. It is gorilla like appearance with large jaws, hands, nose etc. It is due to excess secretion of growth hormone in adults.
2. Name the gland that increases in size during childhood and decreases in size during

adulthood. What important role does it play in case of infection?

- A. Thymus gland plays an important role in the cell mediated immunity and promotes production of antibodies.
- 3. Distinguish between diabetes insipidus and diabetes mellitus.
- A. **Diabetes insipidus :**
 - i) It is due to less secretion of ADH

ii) It causes excess urination

Diabetes mellitus :

- i) It is due to less secretion of insulin.
- ii) It increases blood glucose level.

4. What is insulin shock ?

A. It is due to excess secretion of insulin which decreases blood glucose level.

5. Which hormone is commonly called fight and flight hormone ?

A. Hormones of adrenal medulla are the emergency hormones. Eg : Adrenalin

6. What is erythropoietin ? What is its function?

A. It is hormone produced by kidneys. It stimulates production of RBC.

7. What are Islets of Langerhans ?

A. It is the endocrine portion of pancreas. It secretes the hormones insulin and glucagon.

SHORT ANSWER QUESTIONS

1. Describe the role of hypothalamus as a neuroendocrine organ.

A. The hypothalamus is located at the base of thalamus of the brain.

* It is 'the master control centre' of the endocrine system as it controls pituitary gland.

* It contains neurosecretory cells called Nuclei.

* They secrete :

a) Releasing Hormones :

Eg : Growth hormone releasing hormone (GHRH) (or) Somatotropin.

b) Inhibiting Hormones :

Eg : Growth hormone inhibiting hormone (GHIH) (or) Somatostatin.

* Hypothalamus directly regulates posterior pituitary secretions.

2. Give an account of the secretions of pituitary gland.

A Pituitary gland is also called as hypophysis.

* It is divided into

* Anterior pituitary (Adenohypophysis)

* Posterior pituitary (Neurohypophysis)

17
34
5

* **Secretions of adenohypophysis are :**

- a) Growth hormone
- b) Prolactin
- c) Thyroid stimulating hormone (TSH)
- d) Adrenocorticotrophic hormone (ACTH)
- e) Follicle stimulating hormone (FSH)
- f) Luteinising hormone (LH)

* **Secretions of neurohypophysis are :**

- a) Oxytocin
- b) Vasopressin (ADH)

3. Explain how hypothyroidism and hyperthyroidism can affect the body?

A. Hypothyroidism :

* Hyposecretion of thyroxine hormone causes hypothyroidism.

* It results in

- a) simple goiter
- b) Cretinism
- c) Thyroid dwarf
- d) Myxedema

Hyperthyroidism :

* Hypersecretion of thyroxine hormone causes hyperthyroidism.

* It results in Exophthalmic goiter

4. Write a note on Addison's disease and Cushing's syndrome.

A. Addison's disease :

* Caused due to hyposecretion of glucocorticoids

* Loss of weight, muscle weakness, darkening of skin are the characters of the Addison's disease.

Cushing syndrome :

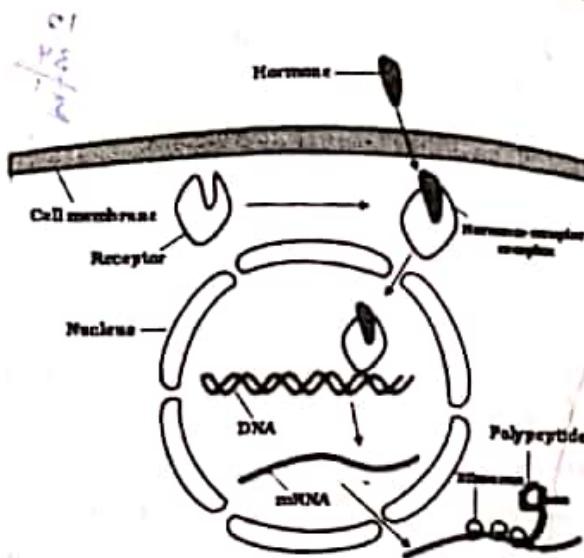
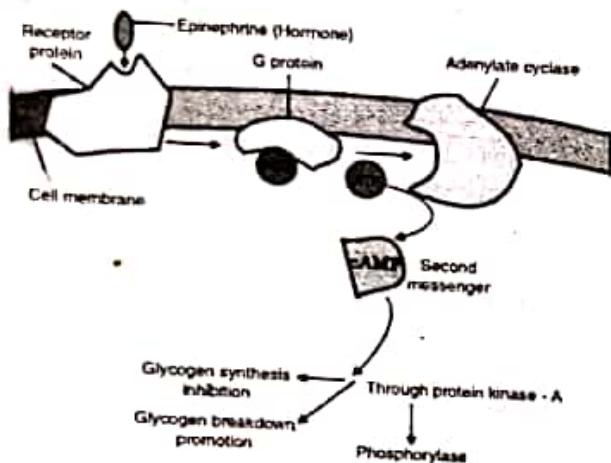
* Caused due to hypersecretion of glucocorticoids.

* Gain of weight, spindly arms and legs, round moon face, pendulous abdomen, buffalo's hump

5. Write a note on mechanism of action of hormones.

A. **Membrane-bound receptor mechanism :**

- The hormones which can not enter the target cell interact with membrane bound receptors.
- G-protein of cell membrane binds to GTP. It activates adenylate cyclase.
- Activated adenylate cyclase forms cyclic AMP. It acts as second messenger.
- The cyclic AMP regulates cellular metabolism. By activating enzymes in a cascade.



Intracellular receptor mechanism :

- The hormones which can diffuse into the cytoplasm of the target cells bind to internal receptors.
- They enter the nucleus and regulate gene expression.

6. Compare a pituitary dwarf and thyroid dwarf in respect of similarities and dissimilarities they possess.

A. **Pituitary dwarf :**

- * Hyposecretion of growth hormone during childhood results in a pituitary dwarf.
- * Pituitary dwarf is sexually and intellectually a normal individual.
- * With short stature

Thyroid dwarf :

- * Hypothyroidism by birth results in thyroid dwarf.
- * Thyroid dwarf shows stunted growth and mental retardation.

IVB - Immune System

4 hours

VERY SHORT ANSWER QUESTIONS

1. What are complement proteins?

- A. They are a group of inactive proteins. When activated they form membrane attack complex. It forms pores in affected cells and make them burst.

2. Colostrum is very much essential for the new born infants. Justify.

- A. It is rich in IgA antibodies which provide natural passive acquired immunity to the infant.

3. Differentiate between perforins and granzymes.

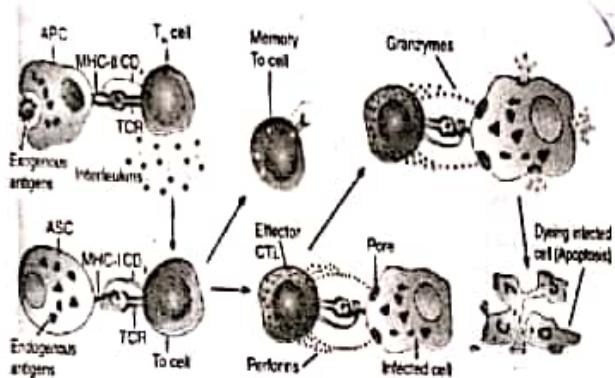
A. **Perforins :**

- * They form pores in cell membrane of infected cells.

Granzymes :

- * Granzymes activate certain proteins (caspases) and cause cell death.

- * Exogenous antigens are processed and displayed by MHC-II of antigen presenting cells. They are recognised by T_H cells and release interleukins.
- * Endogenous antigens are processed by altered self cells and are displayed on their membranes by MHC-I and recognised by T_c cells.
- * Interleukins transform T_c cell into cytotoxic lymphocyte (CTL).
- * CTLs release perforins and granzymes and destruct the infected cells and cancer cells.



5. Explain the mechanism by which HIV multiplies and leads to AIDS.

- A. HIV infects T_H cells, macrophages and dendritic cells.

- * The ss RNA of HIV is converted into viral DNA by reverse transcriptase. The viral DNA is introduced into host cell DNA by integrase enzyme.
- * Then viral DNA transcribes RNA and RNA is translated into viral proteins.
- * Various viral particles are assembled and HIV are bud off from the host cell and T_H cells are destroyed.
- * The progressive decrease in the number of T_H cells leads to AIDS (Aquired Immuno Deficiency Syndrome).

6. Describe various types of barriers of innate immunity.

- A. Innate immunity is the resistance to diseases by birth. It is due to following barriers.

Physical barriers :

- * Skin and mucous membranes.

Physiological barriers :

- * HCl in the stomach, saliva in the mouth, tears from the eyes.

Cellular barriers :

- * Phagocytic cells such as neutrophils, monocytes and natural killer cells.

Cytokine barriers : Interferons.

UNIT-V

HUMAN REPRODUCTION

VA - Human Reproductive System

VERY SHORT ANSWER QUESTIONS

1. What are functions of Sertoli cells and Leydig cells ?

- A. *Sertoli cells* : They provide nutrition to the developing sperms.

- * *Leydig cells* : They secrete androgens such as testosterone. It stimulates spermatogenesis and development of secondary sexual characters.

2. What is implantation with reference to embryo?

- A. It is the attachment of blastocyst to the uterine wall.

3. Define gestation period ? what is its duration in human beings ?

- A. It is the period of development of embryo or foetus in the uterus.

- * It is 266 days (38 weeks).

4. What is parturition ? Which hormones are involved in inducing parturition ?

- A. It is the process of child birth. Oxytocin induces it.

5. What is capacitation of sperms ?

- A. The physiological changes in the sperm which help it to penetrate and fertilize the ovum.

6. Name the yellow mass of cells accumulated in the empty follicle after ovulation. Name the hormone secreted by it and what is its function?

- A. It is corpus luteum. It secretes progesterone which maintains pregnancy for few months.

LONG ANSWER QUESTIONS

1. Describe the female reproductive system of Woman with the help of neat labeled diagram.

A. **Female Reproductive System :**

- * It consists of a pair of ovaries, oviducts, uterus, vagina, external genitalia and accessory glands

Ovaries :

- * These are primary sex organs. They produce ova and hormones such as estrogen and progesterone.
- * It attaches to abdomen by "mesovarium"
- * It contains three regions - Germinal epithelium, tunica albuginea and stroma with cortex & medulla. Cortex shows developing follicles.

Fallopian tube :

- * It extends from ovary and uterus. It has three parts – infundibulum with fimbriae, ampulla and isthmus. It is the site of fertilization.

Uterus :

- * It is also called as "womb"
- * It is a muscular structure open into "vagina" through "cervix"
- * The vagina and cervix form birth canal.
- * It consists of three layers - perimetrium, myometrium and endometrium. Endometrium undergoes cyclic changes during menstrual cycle.

Vagina :

- * It is a fibro-muscular tube
- * It opens into "vestibule" through "vaginal orifice" covered by "hymen"

Vulva / Pudendum :

- * It is external genitalia of female
- * It has fleshy folds labia majora and labia minora
- * The upper junction of labia has clitoris.
- * Vestibule has urethral and vaginal openings.

Accessory glands / Bartholin's glands :

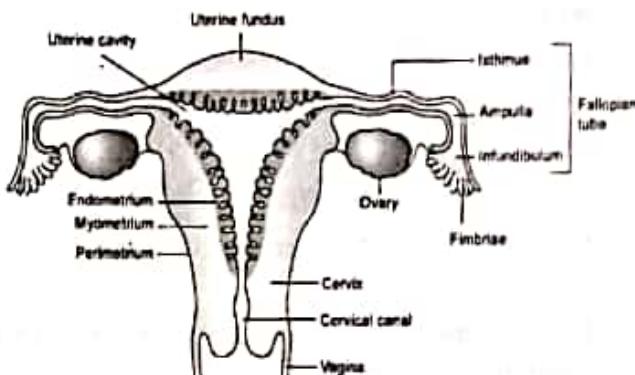
- * Homologous to bulbourethral gland of male
- * They secrete the mucus

Skene's glands :

- * Homologous to the prostate gland of male
- * It secretes the lubricating fluid in vagina

Mammary glands :

- * These are paired structure (breasts).
- * They secrete milk after child birth.
- * These consist of glandular tissue and fat tissue
- * Glandular tissue contains mammary lobes with alveoli, mammary ducts, mammary ampulla and lactiferous duct



2. Describe male reproductive system of man. Draw a neat labeled diagram of it.

- A. It consists of testes, epididymis, vasa deferentia, urethra, external genitalia and accessory glands

Testes :

- * A pair of testes are present in scrotal sacs which help in maintaining low temperature.
- * These are connected to abdomen by inguinal canal. Testis is connected to the abdomen by spermatic cord.
- * They contain many seminiferous tubules.
- * Seminiferous tubules are lined by germinal epithelium. It has spermatogonia that produce spermatozoa and Sertoli cells that nourish sperms.
- * Leydig cells secrete the male hormone testosterone.
- * Seminiferous tubules open into vasa efferentia through rete testis.

Epididymis :

- * These are long, narrow, coiled tubes
- * They give space for storage and maturation of spermatozoa. It is divided into 3 regions.
- * It opens into vas deferens. caput epididymis
corpus epididymis
cauda epididymis

Vasa deferentia :

- * These are long, muscular tubes. They enter into abdomen.
- * They unite with seminal vesicular duct to form ejaculatory duct.
- * Two ejaculatory ducts open into urethra.

Urethra :

- * It is common passage for both sperms and urine.
- * It extends from urinary bladder and ends with urethral meatus in penis.

Penis :

- * It is external genital organ of male
- * It is used to transfer spermatozoa to the vagina of female
- * It is formed by "corpora cavernosa" and "corpus spongiosum"
- * The bulged posterior end of penis is called "glans penis" covered by "prepuce"

Accessory glands / Seminal vesicles :

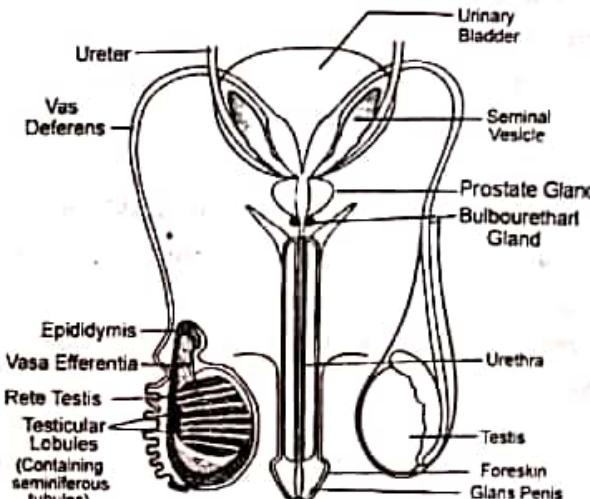
- * They secrete alkaline fluid
- * This fluid contains fructose (energy) and prostaglandins.
- * Prostaglandins help in the contraction of uterus.

Prostate glands :

- * It is located beneath the urinary bladder.
- * It helps for nourishment and activation of spermatozoa.

Bulbourethral / Cowper's glands :

- * These secretions act as lubricating and flushing agents of urethra.



VB - Human Reproductive Health

VERY SHORT ANSWER QUESTIONS

1. What are the measures to prevent contracting STDs ?
 - A. i) Use of condoms
 - ii) Avoiding sex with unknown partners.
2. What in your view are the reasons for population explosion, especially in India?
 - A. i) Decreased death rate i.e., maternal mortality rate and infant mortality rate.
 - ii) Increased health care
3. What is amniocentesis? Name any two disorders that can be detected by amniocentesis ?

- A. The amniotic fluid is tested for diagnosis of genetic disorders, such as Down syndrome, Turner's syndrome etc., before birth.
4. Mention advantages of lactational amenorrhoea method.
 - A. Ovulation does not occur during period of lactation after child birth. It is a natural method of contraception.

SHORT ANSWER QUESTIONS

1. Briefly describe the common sexually transmitted diseases in human beings.
- A. Disease transmitted through sexual contact is called sexually transmitted disease (STD).

These are :

- * Gonorrhoea-*Neisseria gonorrhoea*
- * Genital herpes-Herpes simplex virus (HSV)
- * HIV/AIDS-Human Immunodeficiency Virus (HIV)
- * Hepatitis-B-Hepatitis-B-Virus (HBV)

2. Describe the surgical methods of contraception.

A. The prevention of pregnancy is called contraception.

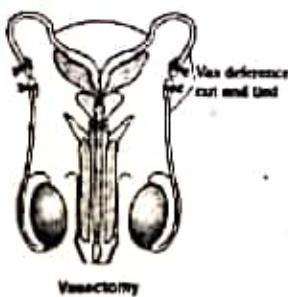
- * Its surgical methods are two types

i. **Vasectomy :**

- * The vas deferens on either side is cut and tied up
- * It prevents discharge of sperms in the seminal fluid.

ii. **Tubectomy :**

- * The fallopian tube on both sides is cut and tied up
- * It prevents the entry of ovum into the fallopian tube.



3. Write short notes on any two of the following.

a) IVF, b) ICSI, c) IUDs

A. a. **IVF-ET : "In Vitro Fertilization and Embryo Transfer"**

- * The fertilization of sperms and ovum takes place outside the body
- * The early embryo is transferred into mother's uterus for development.

b. **ICSI :**

- * Intra cytoplasmic sperm injection
- * The sperms are directly injected into ovum in laboratory
- * The early embryo is transferred to mother's uterus

Stimulated in vitro growth

c. **IUDs :**

- * Intra Uterine Devices
- * These reduce the motility, viability of sperms.
- * These are :
 - i) Non medicated IUD
 - ii) Copper releasing IUD
 - iii) Hormone releasing IUD

4. Suggest some methods to assist infertile couple to have childrens.

A. **1. IVF - ET :**

- * "In Vitro Fertilization and Embryo Transfer"
- * The fertilization of sperm and ovum takes place outside of the body
- * The early embryo is transferred into mother's uterus for development

2. ZIFT :

- * Sperm and ovum are fused in laboratory (outside the body)
- * The zygote is transferred into fallopian tube of mother

3. GIFT :

- * Gamete Intra Fallopian Transfer
- * The ovum of donor is transferred into recipient fallopian tube for fertilization.

4. ICSI :

- * Intra Cytoplasmic Sperm Injection
- * The sperms are directly injected into ovum in laboratory
- * The early embryo transferred to mother's uterus

5. AI :

- * "Artificial Insemination"
- * The sperms are directly introduced into uterus for fertilization

UNIT-VI

Genetics

50

VERY SHORT ANSWER QUESTIONS

1. What is pleiotropy ?
A. It is the phenomenon of multiple effects of a single gene.
Eg : sickle cell anaemia
2. What is polygenic inheritance ?
A. Many genes influence a single character
Eg : Human skin colour, height.
3. What is haplo-diploidy ?
A. In honeybees, fertilized eggs which are diploid develop into females. Unfertilized eggs (haploid) develop into males.
4. What are Barr bodies ?
A. In female mammals one of the X chromosome becomes inactive. It appears as dark stainable body called Barr bodies.
5. What is Klinefelter's syndrome ?
A. It is a genetic disorder caused by trisomy of 23rd pair in males (XXY)
6. What is Turner's syndrome ?
A. It is due to monosomy of 23rd pair in female with a single 'X' chromosome.
7. What are sex limited characters ?
A. They are characters showing their expression which is limited to only one sex.
Eg : beard in man, milk secretion in woman
8. What are VNTRs ?
A. Variable number tandem repeats have repetitive DNA. They are useful as genetic markers.

SHORT ANSWER QUESTIONS

1. Describe erythroblastosis foetalis.
A. Erythroblastosis foetalis is an alloimmune condition. It develops in Rh positive foetus whose father is Rh positive and mother is Rh negative.
* The foetal blood cells pass through the ruptured placenta into the mother's Rh negative blood

- * Mother's immune system identifies Rh positive antigens of foetal RBC and produces Rh antibodies.
- * Rh antibodies pass through placenta, enter the foetal circulation and destroy the blood cells of foetus causing erythroblastosis foetalis.
- * Haemolytic anaemia and jaundice are the symptoms of the disease.
- 2. Mention any two autosomal genetic disorders with their symptoms.
 - A. *Down's syndrome* :
 - * It is caused due to presence of extra chromosome in 21st set (Trisomy 21)
 - * The affected individuals are with small head, partially open mouth, furrowed tongue.
 - * Physical and intellectual development is slow.
 - Edward's syndrome* :
 - * It is caused due to extra chromosome in 18th set (Trisomy 18)
 - * It is more common in female offsprings.
 - * Majority die in foetal stage. Infant who survives has serious defects in heart and liver and die at early age.
- 3. Mention genic balance theory of sex determination.
 - A. Genic balance theory was proposed by Bridges to explain sex determination in Drosophila.
 - * According to this theory, the sex is determined by the balance between genes for femaleness located on X-chromosomes and genes for maleness located on autosomes.
- Sex index (X/A ratio) =
$$\frac{\text{no. of } X \text{ chromosomes}}{\text{no. of sets of autosomes}}$$
- * If X/A ratio is 1, Drosophila is a female.
- * If ratio is 0.5 it is male.
- * If ratio is >1 it is metafemale, if ratio is <0.5 metamale, 0.66 it is intersex.

4. What are auto-immune disorders ? Give two examples.

A. Immune system fails to recognise own body proteins and produces antibodies against them.
Eg : Grave's disease, Rheumatoid arthritis.

5. How can graft-rejections be avoided in patients?

A. Graft rejection is avoided by tissue matching, blood group matching and use of immuno-suppressant drugs.

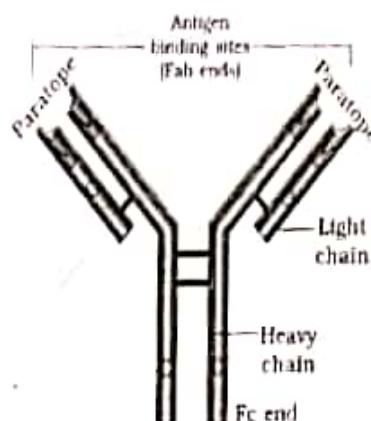
SHORT ANSWER QUESTIONS

① Write a short notes on B-cells.

- A. The lymphocytes which can produce antibodies are B-cells. They play a role in humoral immunity.
- * B-cells are produced by bone marrow in adult mammals.
- * Mature B-cells develop into functional immune cells in secondary lymphoid organs.
- * They have various types of antibodies on their surface.
- * They differentiate into memory cells and plasma cells.
- * Plasma cells produce antibodies.
- * Memory cells store information about the specific antigen.

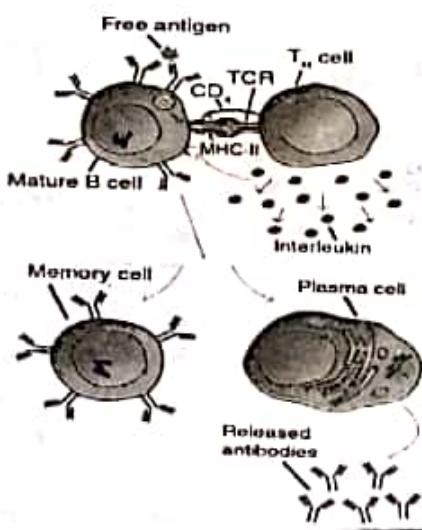
② Write a notes on Immunoglobulins.

- A. Antibodies are the immunoglobulins
- * Antibodies are produced by the B-lymphocytes when any pathogen enters into our body.
- * They are highly specialized for binding with specific antigen.
- * It is 'Y' shaped with 4 polypeptide chains which are 2 heavy chains and 2 light chains.
- * Antibody has two ends F_{ab} and F_c end.
- * The part of antibody which recognises an antigen is called paratope.
- * Based on structure the antibodies are five types IgD, IgE, IgG, IgA, and IgM.



③ Explain the mechanism of humoral immunity.

- A. The immunity mediated by the antibodies of B-cells is called humoral immunity.
- * The antibodies bind to the free antigens and B-cells process them.
- * The processed antigenic fragments are displayed on the membrane of B-cells with the help of class-II MHC molecules.
- * The T_H cells recognise them and release the interleukins.
- * Interleukins stimulate B-cells. They divide and form memory cells and plasma cells.
- * Plasma cells release antibodies.
- * Antibodies bind to the antigens.



④ Explain the mechanism of cell mediated immunity.

- A. The immunity mediated by the T-cells, natural killer cells etc, is known as cell mediated immunity.

4. Explain the inheritance of a sex influenced characters in human beings.
- A. Sex influenced genes are autosomal genes present in both the sexes. The phenotypic expression of heterozygous genotype is dominant in one sex and recessive in opposite sex.
- * Pattern baldness is a sex influenced character.
 - * In homozygous dominant genotype (BB) both males and females are bald.
 - * In homozygous recessive condition (bb) both males and females are non bald.
 - * In heterozygous condition (Bb) males are bald females are non-bald.

5. Write the salient features of HGP.

- A. The human genome is made up of 22 autosomes and X, Y chromosomes.
- * The average gene consists of 3000 bases.
 - * The largest known human gene codes for the protein called dystrophin.
 - * The total number of genes are estimated as 30,000
 - * Less than 2% of the genome codes for proteins.
 - * Chromosome 1 has highest number of genes and chromosome Y has the lowest number.

LONG ANSWER QUESTIONS

1. What are multiple alleles? Describe multiple alleles with the help of ABO blood groups in man.

A. Multiple Alleles :

- * If a gene has more than two alleles in a population, then it is referred to as multiple alleles.
- * Possible genotypes are calculated by using the expression $\frac{n(n+1)}{2}$.
- * The ABO blood group system was proposed by Karl Landsteiner. It is an example of multiple allelism.
- * These phenotypes are inherited by three 'alleles' of the autosomal gene named 'I' located on chromosome 9.

- * Three alleles for the gene Ies I^A , I^B and i (or I^0). I^A and I^B are dominant over I^0 , but codominant to each other.

Blood Group	Geno type
A-blood group	$I^A I^A$ or $I^A I^0$
B-Blood group	$I^B I^B$ or $I^B I^0$
AB blood group	$I^A I^B$
O-blood group	$I^0 I^0$

- * **Blood typing :** Blood type is based on antigen on RBC. Blood group of a person is identified by mixing of blood sample with an antiserum.
- * If clump is formed with 'Anti-A' serum-'A' blood group.
- * If clump is formed with 'Anti-B' serum-'B' blood group.
- * If clump is formed with both 'Anti-A and Anti-B' antisera-AB - blood group
- * If no clump is formed with either of the antisera -'O' blood group

Blood Group A :

- * Antigen 'A' is present on surface of RBC, and anti 'B' antibodies are present in plasma.

Blood Group B :

- * Antigen 'B' is present on surface of RBC, and anti 'A' antibodies are present in plasma.

Blood Group AB :

- * Both antigen 'A' and 'B' are present on surface of RBC and antibodies are absent in plasma.
- * They are universal recipients as they can receive blood from other blood types.

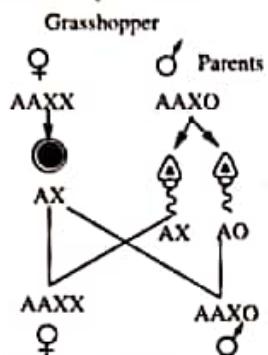
Blood Group O :

- * Antigens are absent on surface of RBC but both anti 'A' anti 'B' anti bodies are present in plasma. They are universal donors as they can donate blood to all other types.

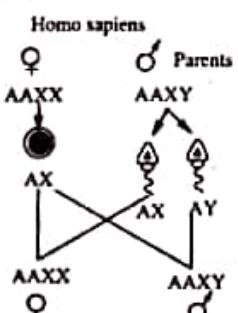
2. Describe chromosomal theory of sex determination.

- A. The process of sex determination by allosomes (sex chromosomes) is called genetic (or) chromosomal sex determination.
- * The sex of the young one is determined at the time of fertilization.

- * **Male Heterogamety** : In this male produces dissimilar gametes that decides sex of the off-spring and female produces similar gametes.
- * **XX-XO type** : In some insects such as bugs, grasshopper & cockroaches females are with two X chromosomes and males are with one X-chromosome.
- * Male produces 2 kinds sperms half of them with X and other half with out sex chromosomes
- * Females (Homogametic) produce only one type of ova with 'AX' complement

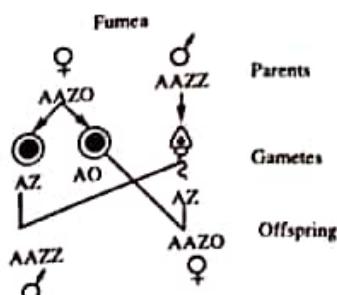


- * **XX-XY type** : This method is seen in human beings and some insects such as Drosophila
- * Males produce two kinds of sperms, half of them with X-chromosome and the other half with Y-chromosome.
- * Females produce similar ova with one X-chromosome
- * The sex of the off-spring depends on the fertilizing sperm.

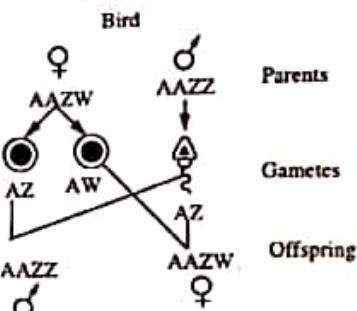


- * **Female heterogamety** : In this type, males produce similar gametes while females produce dissimilar gametes.
- * Sex of the offspring depends on the type of ovum that is fertilised.
- * **ZO-ZZ type** : Female produces two kinds of ova half them with A Z chromosome and the other half with no sex chromosome.

- * Male produces similar types of sperms with 'AZ'.
- Eg : Fumea moths and some butterflies.



- * **ZW - ZZ type** : Female produces two kinds of ova. Half of them with allosome 'Z' and other half with allosome-'W'.
- * Males produce similar sperms with allosome-Z.
- Eg: Fishes, reptiles, Aves.



3. What is Criss Cross inheritance? Explain the inheritance of one sex linked recessive character in human beings.

- A. **Criss Cross inheritance** : It is a type of inheritance in which X-linked recessive genes are transmitted from a father to a grandson through a carrier daughter of the first (F_1) generation.

Eg : Colour blindness, Haemophilia, D.M.D.

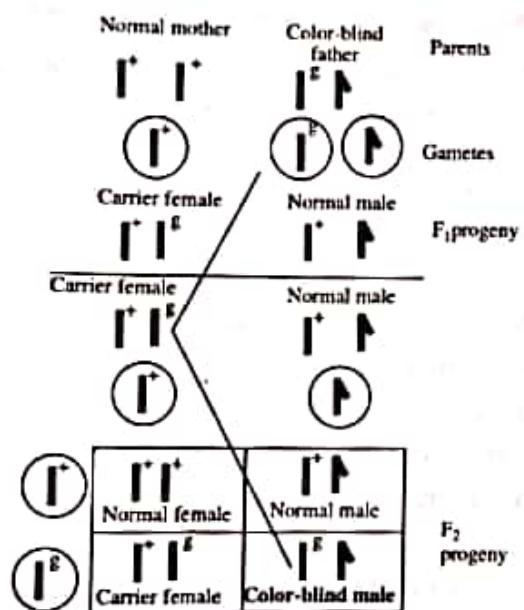
- * **Colour blindness** : It is a sex-linked recessive disorder. Retina of the eye in man contains cone cells sensitive to red and green colour.

- * The alleles for color vision are located on the X-chromosome

- * It is the inability or decreased ability to see certain colours.

Eg : Protonopia (Red colour blindness)

- * Colour blind female always have colour blind father and mother carrier or affected for colour blind.
- * Colour blind male always have carrier / colour blind mother.
- * When woman with normal vision (homozygous) marries a colour blind man all the sons and daughters are normal, but daughters are carriers (heterozygous)
- * If a carrier woman marries a man with normal vision all the daughters have normal vision.
- * Half of the sons have normal vision and another half of the sons are colour blind



4. What is DNA - finger printing? Mention its applications.
- A. DNA - finger printing involves identifying differences in some specific regions in DNA

sequence called 'repetitive DNA'. These sequences show high degree of polymorphism and form the basis of DNA finger printing.

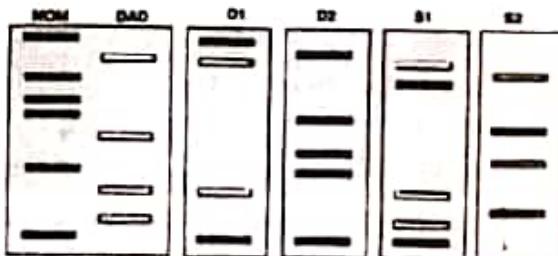
- * The fundamental technique involved in DNA finger printing was introduced by 'Jeffrys'.

DNA Finger printing - Protocol :

- * Obtaining DNA sample from saliva, blood etc.
- * Making the DNA into smaller fragments at specific sites by using restriction enzymes
- * Separation of DNA fragments into individual bands according to size by using electrophoresis
- * Making the double stranded DNA into single strand by alkaline chemicals or by heating
- * Transferring the DNA on to the nylon membrane by Southern blotting.
- * Hybridisation with probe to identify specific DNA.
- * Exposure on photographic film to make a genetic / DNA finger print

Applications :

- * Conservation of wild life
- * Taxonomical applications
- * Pedigree analysis
- * Anthropological studies
- * Medicolegal cases
- * Forensic analysis



UNIT-VII

Organic Evolution

VERY SHORT ANSWER QUESTIONS

1. What are panspermia ?
- A. Life in universe reached the earth in the form of resistant spores called cosmozoa or panspermia.

2. Define prebiotic soup. Who coined term ?

- A. It is boiling water with simple organic molecules on primitive earth J.B.S. Haldane.



3. What are the components of the mixture used by Urey and Miller in their experiments to simulate the primitive atmosphere?

- A. i) H_2O ii) CH_4
 iii) NH_3 iv) H_2

4. Mention the names of any four connecting links.

- A. i) Peripatus
 ii) Prototherians (egg laying mammals)
 iii) Archaeopteryx
 iv) Seymouria

5. Define Biogenetic law with an example.

- A. 'Ontogeny repeats phylogeny'.

Eg : Tadpole larva of frog resembles its ancestor fish.

6. Define atavism with an example.

- A. It is the sudden appearance of vestigial organs in a developed condition.

Eg : tail in human.

7. What is genetic load? Give an example?

- A. It is the existence of harmful genes in a population

Eg : gene for sickle cell anaemia.

8. Distinguish between allopatric and sympatric speciation?

- A. **Allopatric Speciation** : It is speciation by geographical isolation.

- * **Sympatric Speciation** : It is due to reproductive isolation within a population.

9. Define Founder effect. Give one example.

- A. New population separated from a parent population is called founders. Their generations differ from the initial parent population.

Eg : O⁺ blood group in Red-Indians.

10. Mention scientific names of ape like and man like earlier primates. Which man like primate first used hides to cover bodies?

- * *Zopithecus* - ape like
 ova halicus - man like
 other half *erthalensis* used hides

SHORT ANSWER QUESTIONS

1. Distinguish between homologous and analogous organs

A. **Homologous organs :**

- * Organs which have similar structure and origin but may or may not have same function are called homologous organs.

Eg : The flippers of whale, wings of bat, hand of man.

Analogous organs :

- * Organs which have different structure and origin but perform the same function are called analogous organs.

Eg : Wings of a bird and wings of an insect.

2. Write a short note on theory of mutations.

- A. Mutation theory was proposed by Hugo de Vries.

- * He observed mutations in a plant called *Oenothera lamarckiana*.

- * Mutations are sudden discontinuous inheritable changes that occur in naturally breeding populations.

- * Mutations are full fledged, so there are no intermediate forms.

- * Mutations are subjected to natural selection.

3. Explain Darwin's theory of Natural Selection with industrial melanism as an experimental proof.

- A. Industrial melanism was an experimental verification for natural selection.

- * It was conducted by a British ecologist Bernard Kettlewell on peppered moth *Biston betularia*.

- * These moths were in two colours, grey and black.

- * Before industrial revolution, grey moths were abundant because dark moths on light barks of the trees were easily identified and eaten by birds.

- * During industrial revolution the tree barks became dark. Black forms increased in industrial cities like Birmingham due to the increase of pollution.

- * Grey moths on the dark bark were easily identified and eaten more by birds.
- * Nature offered 'positive selection pressure' to light forms before industrial revolution and dark forms after industrial revolution.

4. Discuss the role of different patterns of selection in evolution.

A. Natural Selection is mainly of three types namely

- a) Stabilising selection
- b) Directional Selection
- c) Disruptive selection

a) ***Stabilising selection :***

- * This selection operates in a stable environment.
- * The organisms with average phenotype are selected and organisms with extreme phenotypes are removed.

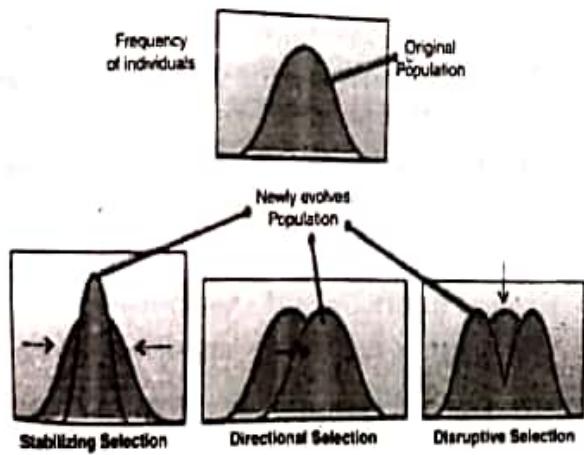
b) ***Directional Selection :***

- * This selection operate in gradually changing environment.
- * It removes the individuals from one end of the phenotype and selecting the individuals towards the other end of the phenotype.

c) ***Disruptive selection :***

- * This selection operates in rapidly changing environment.
- * The organisms with extremes of the phenotype are selected and organisms with average of the phenotype are removed.

Eg : *Bilbo beehive*



5. Write a short notes on Neo-Darwinism.

A. Neo-Darwinism was proposed by Fischer, Sewall Wright, Mayr.

- * According to this theory five basic factors are involved in the process of organic evolution.

* ***Gene mutations :*** Changes in structures of a gene are called gene mutations. They produce variations.

* ***Chromosomal mutations :*** Changes in the structure of chromosomes. They also bring variations in phenotype.

* ***Genetic recombinations :*** They are due to crossing over during meiosis. They also bring heritable variations.

* ***Natural Selection :*** It is a driving force of evolution. Beneficial variations are selected by nature.

* ***Reproductive isolation :*** It is the absence of gene exchange between populations. It results in speciation.

6. What is meant by genetic drift? Explain genetic drift citing the example of founder effect.

A. The change in the frequency of a gene that occurs merely by chance in small populations is called genetic drift.

* The alleles with low frequency are removed by chance resulting in fixation of alleles with high frequency.

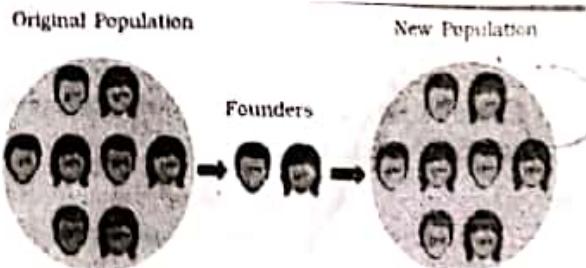
* Genetic drift is of two types.

- 1) Founder Effect
- 2) Bottleneck effect

Founder Effect :

* Founders are a small group of individuals who get separated from their original population and start a new colony in an isolated region. Their offsprings are genotypically similar to their founders rather than to their ancestors.

Eg : O-positive blood group in Red-Indian



VERY SHORT ANSWER QUESTIONS

1. Mention two advantages of inbreeding.
 - A. i) It increases homozygosity
 - ii) It increases productivity

2. What is apiculture ?
 - A. It is Bee keeping for the production of honey and wax.

3. Define the terms layer and broiler
 - A. *Layer* : Birds raised for eggs
 - Broiler* : Birds raised for only meat.

4. Explain the term hypophysation.
 - A. It is induced breeding by injecting pituitary extracts of gonadotropins (FSH and LH) into brood fish.

5. Differentiate between aquaculture and pisciculture
 - A. *Aquaculture* : Culture of aquatic organism such as fishes, prawns, crabs etc..
 - Pisciculture* : Culture of fishes. *e.g. cod, salmon*

6. List any two Indian carps and two exotic carps.
 - A. *Indian carps* : Catla, Rohu
 - Exotic carps* : Silver carp, Common carp.

7. Mention any four fish by products.
 - A. i) Shagreen
 - ii) Isinglass
 - iii) Omega 3 fatty acid
 - iv) Fish guano

8. Define the term 'vaccine'
 - A. It is a biological preparation of weakened or killed forms of the microbe which improves immunity.

9. What does ADA stand for? Deficiency of ADA causes which disease?
 - A. ADA stands for adenosine deaminase. Deficiency causes severe combined immunodeficiency.

10. What is popularly called 'Guardian Angel of Cell's Genome' ?

- A. P53 protein produced by P53 gene is the Guardian Angel of cell's genome.

11. Define the term transgenic animal.

- A. It is the animal with its own genome and extra foreign genes. Eg: Rosie - transgenic cow with human gene for alpha-lactalbumin.

12. What does prolonged P-R interval indicate?

- A. It indicates delay in conduction from S.A node and slow beating of heart - bradycardia.

13. Differentiate between primary and secondary antibodies.

- A. Primary antibody reacts with antigen. Secondary antibody reacts with primary antibody.

14. Which substances in a sample are detected by direct and indirect ELISA respectively?

- A. Direct ELISA is for detecting antigens in the sample.
- Indirect ELISA is for detecting antibodies.

SHORT ANSWER QUESTIONS

1. List out various steps involved in MOET
 - A. Following are the steps involved in multiple ovulation and embryo transfer [MOET].
 - * In the first step FSH and LH hormone injections are given to selected cows.
 - * These hormones cause release of multiple eggs, usually 6 to 8. i.e super ovulation.
 - * The cow is then allowed to mate with a good quality bull.
 - * After fertilization the embryos at 8 to 32 celled stages are transferred and grown in surrogate mothers.

2. Explain in brief about Queen bee.
 - A. Queen bee is the fertile, largest bee in the bee colony.
 - * It is a diploid organism.
 - * She lives for 5 years.

- * Queen bee's function is to lay eggs. During nuptial flight the queen bee receives sperms from male bees.
 - * She lays two types of eggs, fertilized and unfertilized.
 - * Fertilized eggs develop into females and unfertilized eggs develop into males.
- 3. Define vaccine and discuss about types of vaccines.**
- A. Vaccine is a prophylactic measure against some infections.
There are three types of vaccines.
- Attenuated whole agent vaccines :**
- * They contain live but disabled organisms.
Eg : Vaccines against mumps, typhoid
- Inactivated whole agent vaccines :**
- * They contain killed microorganisms.
Eg : Vaccines against influenza, Cholera
 - * Toxoids : They contain toxoids.
Eg : Vaccines against diphtheria, tetanus
- 4. Write in brief the types of gene therapy.**
- A. Gene therapy is insertion of genes into cells and tissues to treat hereditary problems.
- * There are two main types
- Germ line gene therapy :**
- * In this method normal genes or functional genes are introduced into sperm / ovum. These changes are heritable.
- Somatic line gene therapy :**
- * In this method normal genes are introduced into somatic cells of a patient. Changes here are non heritable.
It is of two types.
 - a) **Ex vivo therapy**
The cells are modified outside the body
 - b) **In vivo therapy**
The genes are changed in cells, inside the body
- 5. List out any four salient features of cancer cells.**
- A. Cancer is characterized by uncontrolled cell division
- * They lack contact inhibition and grow rapidly.
 - * They detach easily due to lack of cadherins. They cause secondary tumors (Metastasis). Cadherins are intercellular adherence proteins.
 - * They do not undergo apoptosis. Apoptosis is also known as programmed cell death.
 - * They promote angiogenesis.(development of blood vessels for nutrients to tumours).
- 6. Explain different types of cancers.**
- A. Following are the different types of cancers
- * **Carcinomas** : These are the cancers of epithelial tissues.
 - * **Sarcomas** : These are the cancers of connective tissue.
 - * **Leukemias** : these are the cancers of bone marrow stem cells.
 - * **Lymphomas** : These are the cancers of the lymphatic system
 - * **Familial cancers** : they are hereditary cancers.
 - * **Sporadic cancers** : These are the non hereditary cancers.
- 7. Write about the procedure involved in MRI.**
- A. It is a non invasive test used in medical field. MRI is very helpful in the diagnosis of cancers.
- * MRI scanner is a big circular magnetic tube.
 - * MRI uses powerful magnetic field, radio frequency pulses and a computer to generate images of internal organs.
 - * Each tissue has a different appearance on the film based on their water content.
 - * Sometimes a radiocontrast substance called gadolinium is used to increase the clarity of the image.
- 8. Write briefly about different waves and intervals in an ECG.**
- A. Electrocardiogram is a non invasive method of recording heart's electrical activity.
- * This electrical activity is recorded on a paper in a graphical form.

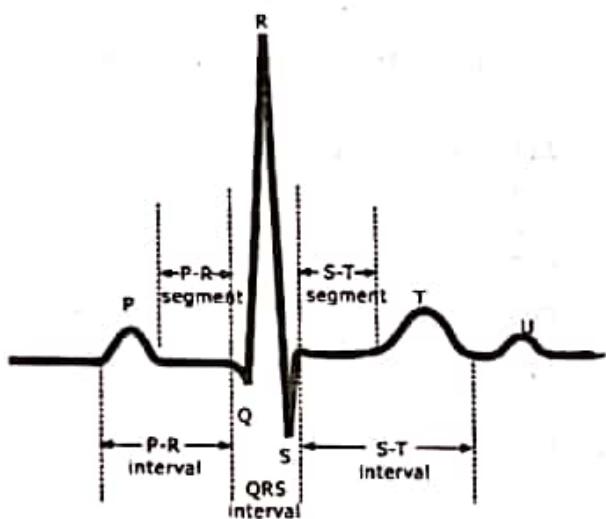
- * An electrocardiogram consists of waves, complexes, intervals and segments.

Waves :

- 1) **P wave** : It represents the atrial systole.
- 2) **QRS complex** : It represents ventricular systole.
- 3) **T wave** : It represents ventricular repolarisation.

Intervals :

- 1) **P-R interval** : Time between P and Q wave.
- 2) **Q-T interval** : Time between Q and end of T wave.
- 3) **R-R interval** : It indicates one cardiac cycle.



9. Discuss briefly the process of indirect ELISA.

- ELISA is short form for Enzyme Linked Immuno sorbent Assay.
- * Indirect Elisa is a process that is used to detect antibodies. HIV test is an example for Indirect Elisa.

- * In this method serum of a suspected patient is added to an antigen coated microtitre plate.
- * Primary antibodies in the serum bind to the antigen.
- * Enzyme linked secondary antibody is then added to this antigen antibody complex, followed by enzyme substrate.
- * The resulting reaction between enzyme and enzyme substrate produces a colour change.
- * The colour change is read by a spectrophotometer.
- * If there is no change in the colour, the test result is negative. If there is change in the colour, the test result is positive.

10. Write short notes on EEG.

- EEG is short form for Electroencephalogram.
- * It is used in the diagnosis of certain neurological and sleep disorders.
- * Electrical activity of the brain is recorded in the form of waves. There are 4 types of waves
- * **Alpha waves** : They occur at a frequency of 8 to 13 cycles per second. They are produced in persons who are drowsy.
- * **Beta waves** : They occur at a frequency of 13 to 40 cycles per second. They are recorded in mentally active and tense persons.
- * **Delta waves** : They occur at a frequency of 3 cycles per second in adults during deep sleep.
- * **Theta waves** : They occur at a frequency of 4 to 7 cycles per second. They are recorded during emotional stress in adults.