PART: I – INTRODUCTION

- Chemistry plays a very important role in day to day life.
- There are different types of branches comes under chemistry.
- **Biochemistry** is a branch of chemistry which deals with Knowledge that goes on chemically within a living system to create life.
- The term "Biochemistry" was coined in 1903 by German chemist named Carl Neuber while studying about living system.
- Biochemistry is often called Biomolecules.
- The four main classes of biomolecules are carbohydrates, proteins, lipids, and nucleic acids.

NOTE:

- ✓ Cell is a basic structural and functional unit of life.
- ✓ Cell contains biomolecules such as C.P.L.Have.V.I.N.E.

- **MEANING OF BIOMOLECULES** : (Bio = life & Molecules = Any chemical substance)

  A Biomolecule is Any molecule that is produced by living organism.

  i.e. (living organism – Plants, Human being, Other Animals)

- **DEFINITION OF BIOMOLECULES:**

  Biomolecules are ***lifeless molecules*** which combine in a specific manner to produce a life or control the biological processes.

- **EXAMPLES OF BIOMOLECULES :**

1. Carohydrates: Process of photosynthesis plants produce carbohydrates.
2. Proteins: Plants utilize the minerals absorbed by their roots to produce proteins.
3. Lipids: Lipids are the main ingredient of vegetable oils and milk fats.

4. Hormones: Hormones are chemical messenger secreted by endocrine glands.
5. Vitamins: Vitamins which are essential for normal growth and nutrition and are required in small quantities in the diet.
6. Insulin: Insulin is a hormone that plays a central role in controlling blood sugar levels in the body.
7. Nucleic Acid: Nucleic acids constitute the genetic material of organisms.(DNA & RNA)
8. Enzyme: Enzymes are bio-catalyst which performs biological reaction.

NOTE:
As Per Syllabus the Four Principal Biomolecules Namely, Carbohydrates, Proteins, Nucleic Acids and Enzyme.

PART – I – EXERCISE: IMPORTANT QUESTION – (EACH 1 MK)

1. Define Biochemistry.
2. Define Biomolecules. .
3. Biomolecules are also called as?
4. Write examples of biomolecules
5. What are the constituents of balanced diet?
6. What are the products of digestion of carbohydrates?
7. Which constituent of diet is useful for building muscles?
8. Which constituent of diet is a source of high energy?
9. What is the genetic material of organisms?

PART: II – CARBOHYDRATES

INTRODUCTION:

- It is a naturally occurring biomolecules.
- It is an organic compound containing Carbon, Hydrogen and Oxygen only.
- It is primarily produced by plants (example: cellulose, starch, wheat, rice, corn etc.) and secondarily produced by animals (example: milk , honey etc.).
- It is also known as Saccharides because the term saccharide is derived from Greek word "sakkharon" means sugar which is sweet in taste. (Except cellulose , starch)
- The general formula of carbohydrate is $C_x(H_2O)_y$ or $C_n(H_2O)_n$ and were considered as hydrates of carbon.
- The definition based on general formula and Hydrates of carbon do not satisfied all the conditions of carbohydrates.
- Example:

Case: I

Name of Compound	Formula	General Formula $C_n(H_2O)_n$
Glucose	$C_6H_{12}O_6$	$C_6(H_2O)_6$
Fructose	$C_6H_{12}O_6$	$C_6(H_2O)_6$
Sucrose	$C_{12}H_{22}O_{11}$	$C_{12}(H_2O)_{11}$
Raffinose	$C_{18}H_{32}O_{16}$	$C_{18}(H_2O)_{16}$
Stachyose	$C_{24}H_{42}O_{21}$	$C_{24}(H_2O)_{21}$

Above examples satisfied general formula and sweet in taste.

Case: II

Name of Compound	Formula	General Formula $C_n(H_2O)_n$
Formaldehyde	$C_1H_2O_1$	$C_1(H_2O)_1$
Acetic acid	$C_2H_4O_2$	$C_2(H_2O)_2$

Above examples satisfied general formula but not sweet in taste.

Case: III

Name of Compound	Formula	General Formula $C_n(H_2O)_n$
Rhamnose	$C_6H_{12}O_5$	x

Above example do not satisfied general formula but sweet in taste.

- **CONDITIONS FOR CARBOHYDRATES:**

It must contain

1. Minimum 3 carbon atom (All are sp^3 hybridized except one is sp^2)
2. Minimum one carbon is optically active(Asymmetric carbon)
3. More than one –OH group. (Polyhydroxy)
4. Either Ketonic group (– CO –) or Aldehyde group (– CHO).

NOTE: If Carbohydrate is in ring form than it must contain Hemiacetyl group/Hemiketal group.

- **DEFINITION OF CARBOHYDATES:**

Carbohydates are optically active polyhydroxy aldehydes or polyhydroxy ketones or the compounds that on hydrolysis produce polyhydroxy aldehyde or polyhydroxy ketone.

- Example :

1. Glucose($C_6H_{12}O_6$) + H_2O → Glucose Solution

(Glucose is a optically active polyhydroxy aldehyde which cannot be hydrolysed further because it already exist in simplest form)

2. Sucrose($C_{12}H_{22}O_{11}$) + H_2O → Glucose ($C_6H_{12}O_6$) + Fructose ($C_6H_{12}O_6$)
   polyhydroxy aldehyde polyhydroxy ketone

(Sucrose is a complex carbohydrates which can be hydrolysed to form Glucose is a optically active polyhydroxy aldehyde and Fructose is optically active polyhydroxy ketone)

CLASSIFICATION OF CAROHYDRATES:

NOTE:

Carbohydrates can be broadly classified into Three Types

I. Classification based on Hydrolysis
II. Classification based on Solubility
III. Classification based on Reducing properties.

AS PER SYLLABUS WE NEED TO STUDY ONLY CLASSIFICATION BASED ON HYDROLYSIS

- Carbohydrates are broadly classified on the **Basis of hydrolysis** into three types.

1. Monosaccharides :

- Definition: A carbohydrates which cannot be hydrolyzed further into smaller units of polyhydroxy aldehydes or ketones are called monosaccharides.
- There are 20 monosaccharides are occur in nature.
- Monosaccharides contain C3 – C8.
- Most common carbohydrates have 5 – carbon called Pentose and 6 – carbon called Hexose.
- The formula of Monosaccharides is $C_nH_{2n}O_n$.
- Example: $C_5H_{10}O_5$ - Ribose, $C_6H_{12}O_6$ - Glucose, Fructose etc.

2. Oligosaccharides :

- Definition: A carbohydrates that on hydrolysis yield two to ten units of monosaccharides are called Oligosaccharides.
- They are further classified as disaccharides to decasaccharides.
- Example: Sucrose, Maltose, Lactose, Raffinose, Stachyose etc.
- **Disaccharides:**

The Disaccharides have formula $C_nH_{2n-2}O_{n-1}$.

Disaccharides contain 12 – carbon atoms and formula $C_{12}H_{22}O_{11}$.

Disaccharides on hydrolysis yield two units of monosaccharides have formula $C_6H_{12}O_6$.

Example:

1. $\underset{C_{12}H_{22}O_{11}}{\text{Sucrose}} \xrightarrow[H_2O]{\text{Hydrolysis}} \underset{C_6H_{12}O_6}{\text{Glucose}} + \underset{C_6H_{12}O_6}{\text{Fructose}}$

2. $\underset{C_{12}H_{22}O_{11}}{\text{Maltose}} \xrightarrow[H_2O]{\text{Hydrolysis}} \underset{C_6H_{12}O_6}{\text{Glucose}} + \underset{C_6H_{12}O_6}{\text{Glucose}}$

3. $\underset{C_{12}H_{22}O_{11}}{\text{Lactose}} \xrightarrow[H_2O]{\text{Hydrolysis}} \underset{C_6H_{12}O_6}{\text{Galactose}} + \underset{C_6H_{12}O_6}{\text{Glucose}}$

- **Trisaccharides:**

The Trisaccharides have formula $C_nH_{2n-4}O_{n-2}$.

Trisaccharides contain 18 – carbon atoms and formula $C_{18}H_{32}O_{16}$.

Trisaccharides on hydrolysis yield three units of monosaccharides have formula $C_6H_{12}O_6$.

Example:

1. $\underset{C_{18}H_{32}O_{16}}{\text{Raffinose}} \xrightarrow[2\,H_2O]{\text{Hydrolysis}} \underset{C_6H_{12}O_6}{\text{Glucose}} + \underset{C_6H_{12}O_6}{\text{Fructose}} + \underset{C_6H_{12}O_6}{\text{Galactose}}$

- **Tetrasaccharides:**

The Tetrasaccharides have formula $C_nH_{2n-6}O_{n-3}$.

Tetrasaccharides contain 24 – carbon atoms and formula $C_{24}H_{42}O_{21}$.

Tetrasaccharides on hydrolysis yield four units of monosaccharides have formula $C_6H_{12}O_6$.

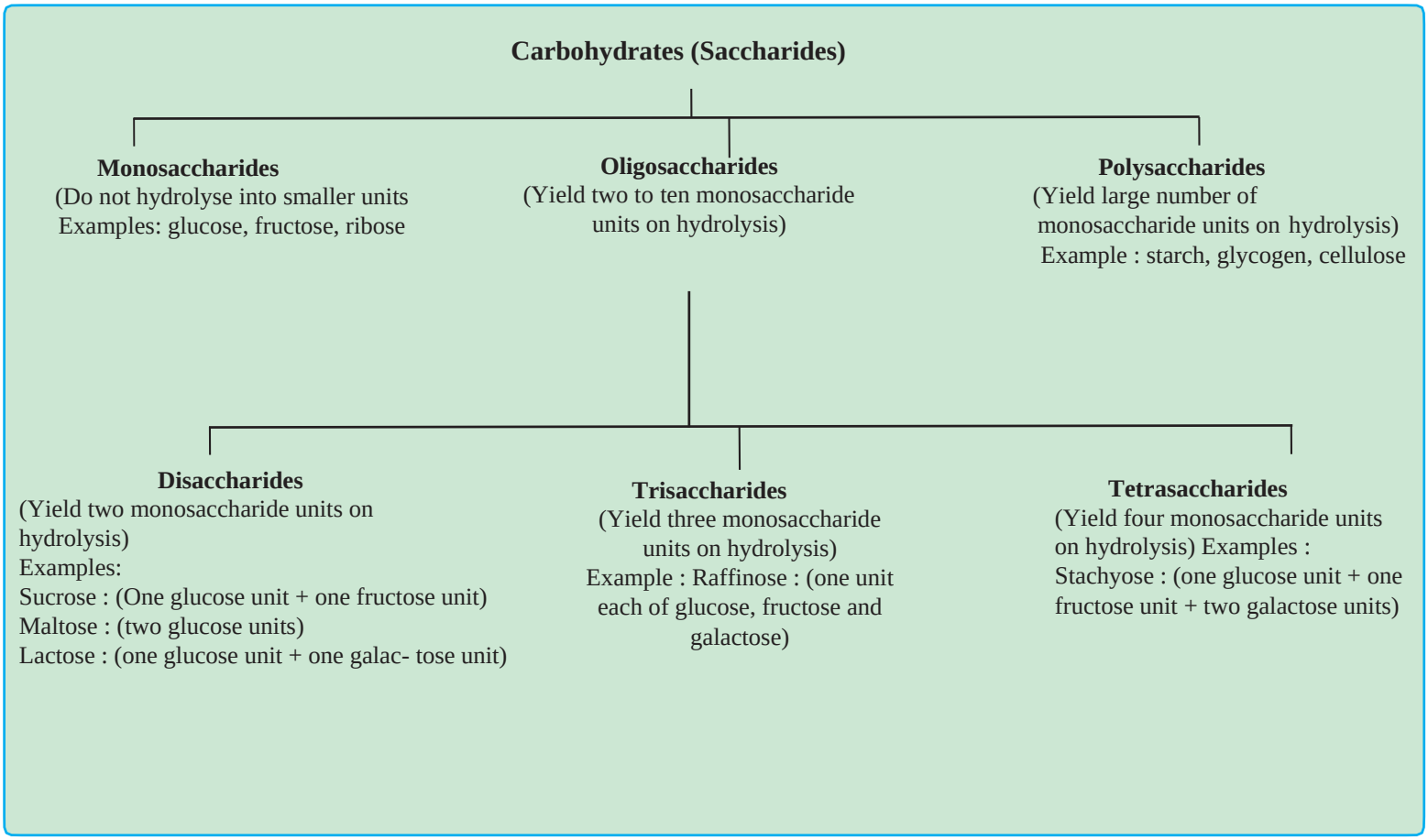
Example:

1. $\underset{C_{24}H_{42}O_{21}}{\text{Stachyose}} \xrightarrow[3\,H_2O]{\text{Hydrolysis}} \underset{C_6H_{12}O_6}{\text{Glucose}} + \underset{C_6H_{12}O_6}{\text{Fructose}} + \underset{C_6H_{12}O_6}{\text{Galactose}} + \underset{C_6H_{12}O_6}{\text{Galactose}}$

3. Polysaccharides :

- Definition: A carbohydrates that on hydrolysis yield very large (more than ten) number of monosaccharide units are called Polysaccharides.
- Most common polysaccharides are obtained from plants and animals.
- Example: Starch, Cellulose, Glycogen, Inulin, Marine gum, Pectin, Chitin Etc.

1. $\underset{(C_6H_{10}O_5)_n}{\text{Starch}} \xrightarrow[n\,H_2O]{\text{Hydrolysis}} \underset{C_6H_{12}O_6}{n\,\text{Glucose}}$



PART – II – EXERCISE – 1 : IMPORTANT QUESTION – (EACH QUESTION – 2 Mark)

1. Name the functional group present in carbohydrates.
2. Write the condition of Carbohydrates.
3. Define Carbohydrates. Write its example.
4. What is carbohydrates? How carbohydrates are classify based on hydrolysis?
5. Identify the carbohydrates into Monosaccharides, Disaccharides, Trisaccharides, Tetrasaccharides and Polysaccharides.
   a. Ribose
   b. Glucose
   c. Fructose
   d. Starch
   e. Cellulose
   f. Raffinose
   g. Stachyose
   h. Glycogen

NOMENCLATURE OF MONOSACCHARIDES:

- According to IUPAC system of nomenclature, general name for monosaccharide is **Glycose**.
- Monosaccharide with one aldehydic carbonyl group is called **Aldose.**
- Monosaccharides with one ketonic carbonyl group is called **Ketose**.
- Monosaccharides will be further classified on the basis of number of carbon atoms.

Molecular formula	Class of Aldose	Example
$C_3H_6O_3$	Aldotriose	Glyceraldehyde
$C_4H_8O_4$	Aldotetrose	Erythrose , Threose
$C_5H_{10}O_5$	Aldopentose	Ribose , Arbinose
$C_6H_{12}O_6$	Aldohexose	Glucose , Mannose

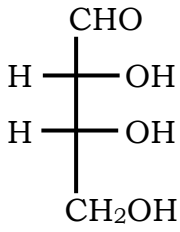
Molecular formula	Class of Ketose	Example
$C_3H_6O_3$	Ketotriose	Dihydroxyacetone
$C_4H_8O_4$	Ketotetrose	Erythrulose
$C_5H_{10}O_5$	Ketopentose	Ribulose
$C_6H_{12}O_6$	Ketohexose	Fructose

- **NOTE : RULES FOR WRITING FORMULA OF CARBOHYDRATES:**

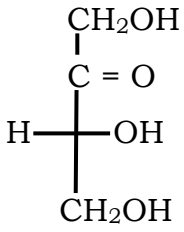
1. Carbohydrates can be represented by molecular formula, condensed formula, structural formula , Fischer projection formula and Haworth projection formula.
2. Fischer projection is the most common representation for carbohydrates.

RULE NO: 1: FISCHER PROJECTION FORMULA ; (+)

- A compound in which tetrahedral carbon atom is represented by two cross line are called Fischer projection formula.
- *Horizontal line* represents a bond which is coming outside of the plane of paper having one side –OH group and other side –H atom.
- *Vertical line* represents a bond which is coming inside of the plane of paper having most oxidized carbon at the top (Either Aldehydic or Ketonic group) and least oxidized carbon at the bottom. ($-CH_2-OH$ group).



Aldose structure



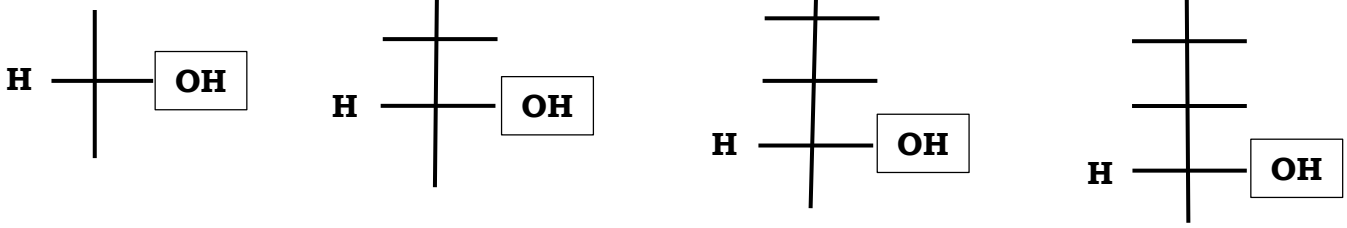
Ketose structure

RULE NO: 2 : D & L CONFIGURATION SYSTEM /FAMILY/SUGAR

- The system that is used to designate the configurations of chiral carbons of naturally occurring compound is called the D and L convention or system.
- D and L system can be represented by horizontal line. (Last horizontal line)

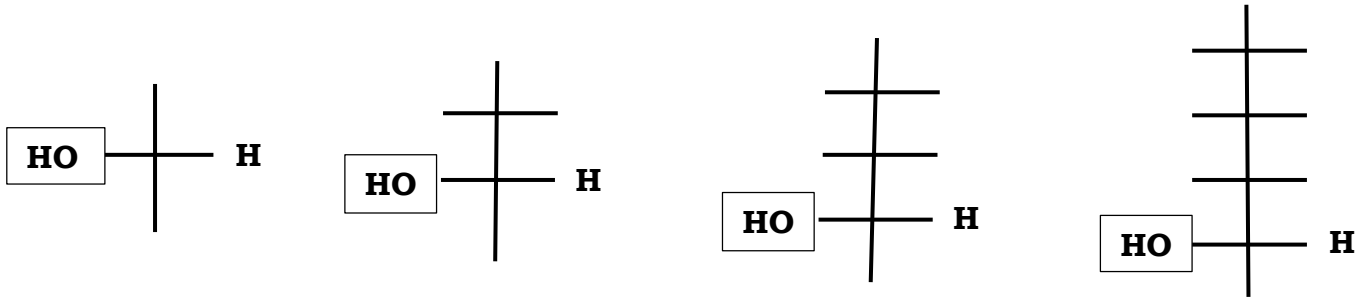
D – CONFIGURATION: (D-means Right side)

If OH group is placed on right side of last horizontal line (chiral carbon) than it is D – Sugar.



L – CONFIGURATION: (L-means Left side)

If OH group is placed on Left side of last horizontal line (chiral carbon) than it is L – Sugar



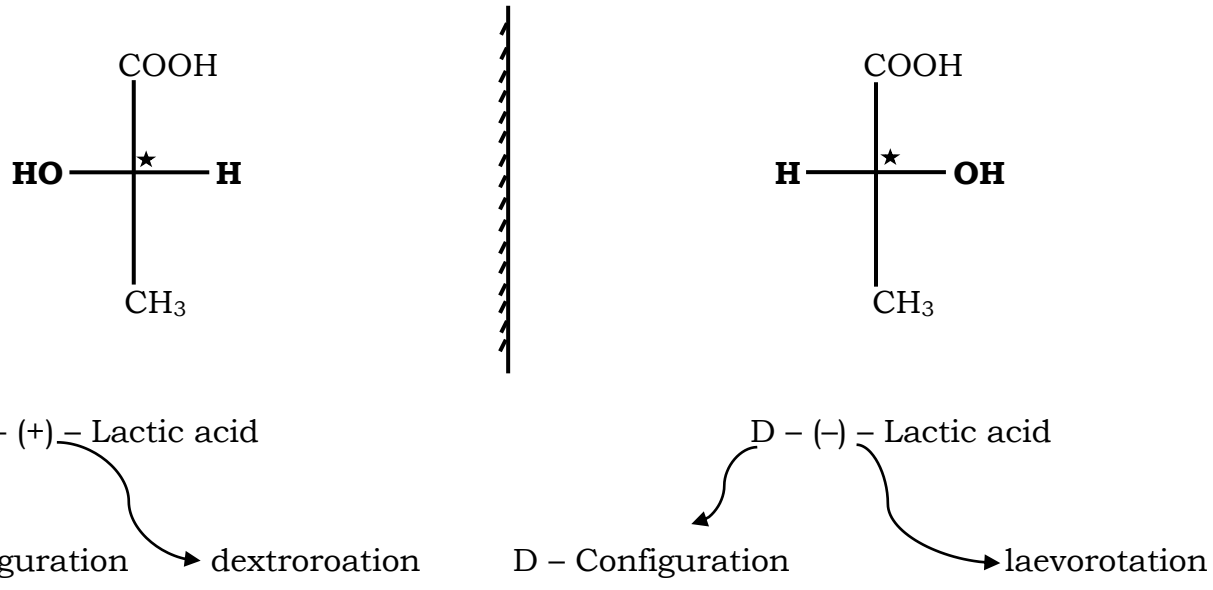
RULE NO: 3: (OPTICAL ISOMERISM)

- Optical isomers are two compounds which contain the same number and kinds of atoms, and bonds (i.e., the connectivity between atoms is the same), and different spatial arrangements of the atoms, but which have ***non-superimposable mirror images*** & phenomenon is known as optical isomerism.
- Each non-superimposable mirror image structure is called an ***enantiomer***.
- Enantiomer is one of two stereoisomers that are mirror images of each other that are non-superimposable, much as one's right (dextrotatory)(d)(+) and left (laevorotatory)(*l*)(-) hands are mirror images of each other that cannot appear identical simply by reorientation.
- Enantiomers can be alternately defined as optical isomers that are non-superimposable mirror images of each other due to presence of chiral carbon atoms.
- Optical isomer which can be determined using formula,

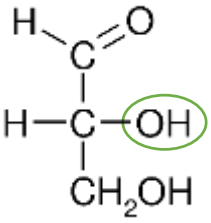
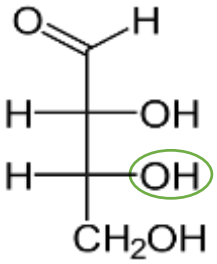
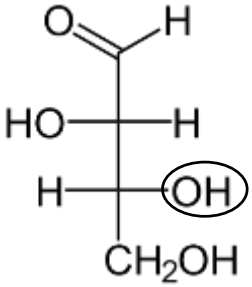
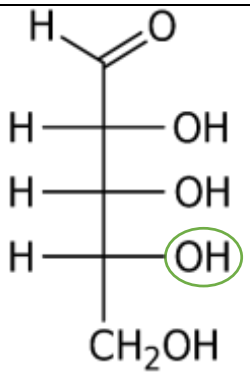
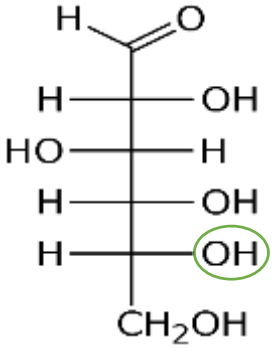
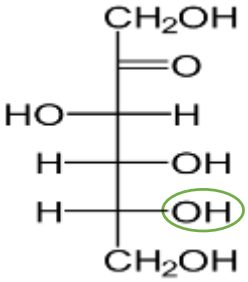
$$\textbf{Optical isomers} = 2^{n}$$

Where n = number of chiral carbon atom.

- Example : Optical isomers = $2^n = 2^1 = 2$ optical isomers (n = chiral carbon atom is 1)

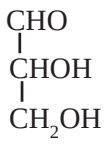
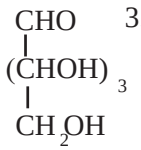
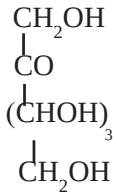


Dextro – rotation and Laevo rotation of compound can be determine by using Polari meter machine only Where D & L configuration can be determine by representing OH group placed on last horizontal line(Chiral carbon)

Structural formula	Name of Class	Famous name
	Aldotriose	Glyceraldehyde D – (+) – Glyceraldehyde
	Aldotetrose	Erythrose D – (–) – Erythrose
	Aldotetrose	Threose D – (–) – Threose
	Aldopentose	Ribose D – (–) – Ribose
	Aldohexose	Glucose D – (+) – Glucose
	Ketohexose	Fructose D – (–) – Fructose

PART – II – EXERCISE – 2: IMPORTANT QUESTION – (EACH QUESTION – 2 Mark)

1. Write the general name of Monosaccharides. (1 M)
2. Write the examples of Aldoses having different carbons in Monosaccharides.
3. Write the examples of Ketoses having different carbons in Monosaccharides.
4. Write the IUPAC name of following monosaccharides.

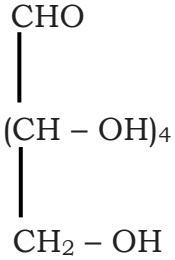
1. 
2. 
3. 

5. Write the Fischer projection formula of following monosaccharides.
   1. D – (+) – Glucose
   2. D – (–) – Fructose
   3. D – (–) – Ribose
   4. D – (+) – Glyceraldehyde

GLUCOSE :

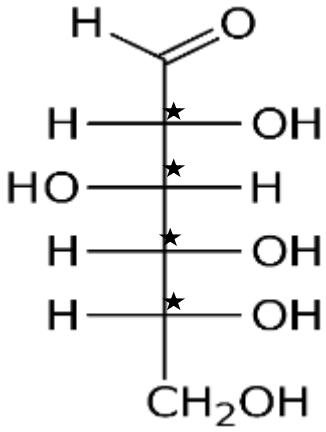
- **INTRODUCTION:**

1. Glucose occurs in nature in free as well as in combined state.
2. It is present in sweet fruits, honey and essential component of human blood.
3. It is most abundant monosaccharides present in nature.
4. It produces instant energy and available in Dextrose form.
5. Glucose is a optically active pentahydroxy aldehyde contain 4 chiral carbon atom.
6. Molecular formula : $C_6H_{12}O_6$
7. Structural formula :



NOTE: 1 – Primary Alcoholic group (– CH_2 – OH) and
4 – Secondary alcoholic group (>CH – OH)

8. Fischer projection formula: D – (+) – Glucose



NOTE: 4 – Chiral carbon atom, Optical isomers = $2^n = 2^4 = 16$

- **METHOD OF PREPARATION OF GLUCOSE**:

METHOD – I – LABORATORY METHOD – [FROM SUCROSE]

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[333\ K,\ 2\text{ - }3\ Hours]{\text{Dil. HCl or Dil. } H_2SO_4} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

Explanation:

1. Sucrose is hydrolyzed by warming with dilute hydrochloric acid or sulfuric acid for about two hours to undergo hydrolysis and converts sucrose into mixture of glucose and fructose.
2. Glucose is separated from fructose by adding ethanol during cooling where glucose being almost insoluble in alcohol crystallizes out first. The solution is filtered to obtain crystals of glucose.

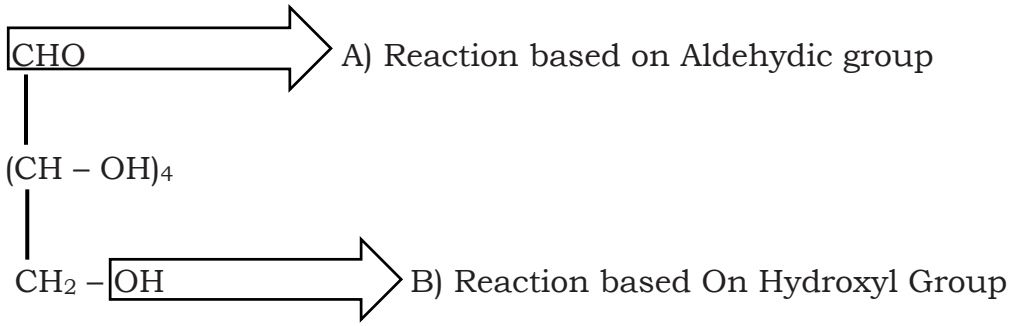
METHOD – II – COMMERCIAL METHOD – [FROM STARCH]

$$\underset{\text{Starch}}{(C_6H_{10}O_5)_n} + n\,H_2O \xrightarrow[393\ K,\ 2\text{ - }3\ atm,\ pressure]{\text{Dil. HCl or Dil. } H_2SO_4} n\,\underset{\text{Glucose}}{C_6H_{12}O_6}$$

Explanation:

1. Commercially glucose is obtained by hydrolysis of starch by boiling it with dilute sulfuric acid at 393K under 2 to 3 atm pressure.
2. The glucose formed during the process is acidic and can be neutralized with chalk powder which further mixed with charcoal powder to remove all the impurity from glucose.
3. Finally Glucose is heated and cooling produces pure crystal of glucose.

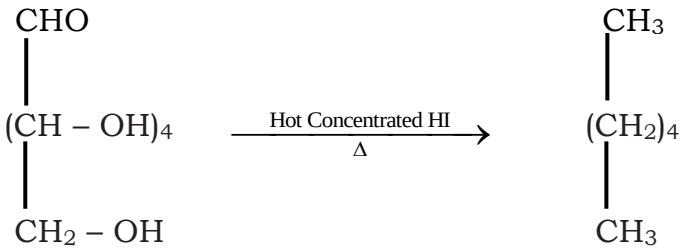
- **CHEMICAL PROPERTIES OF GLUCOSE:**



A) Reaction based on Aldehydic group:

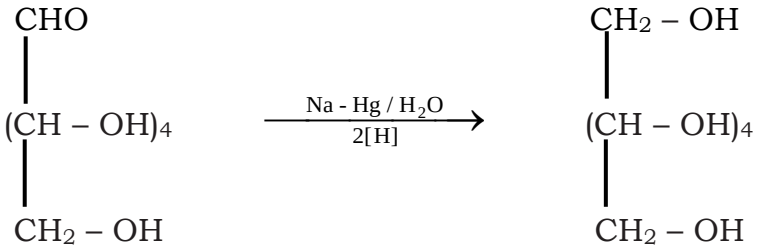
1. Reduction of Glucose: → **Strong Reducing Agent**

a) Complete reduction : (Using Hot Con. HI)



Glucose **n – Hexane**

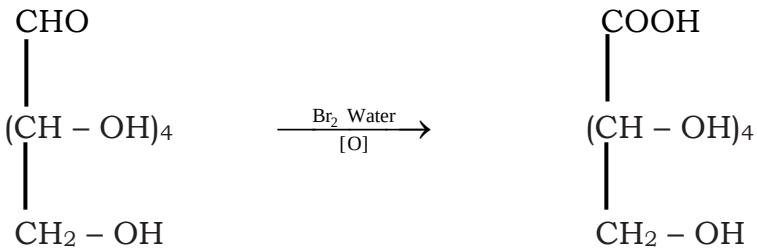
b) Partial reduction : (Using Na – Hg /H_2O) → **Mild Reducing Agent**



Glucose **Sorbitol**

2. Oxidation of Glucose: → **Mild Oxidizing Agent**

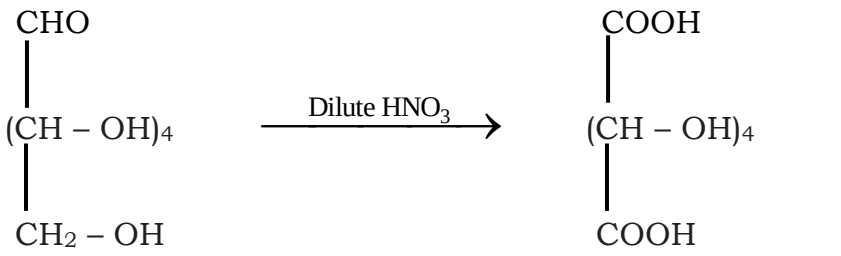
a) Partial oxidation : (Using Br_2 - Water)



Glucose **Gluconic Acid**

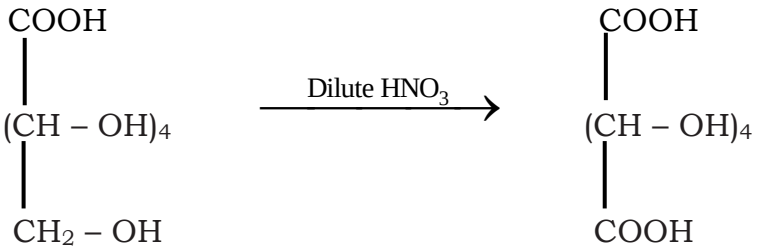
b) Complete Oxidation : (Using Dilute HNO_3) → **Strong oxidizing Agent**

i.



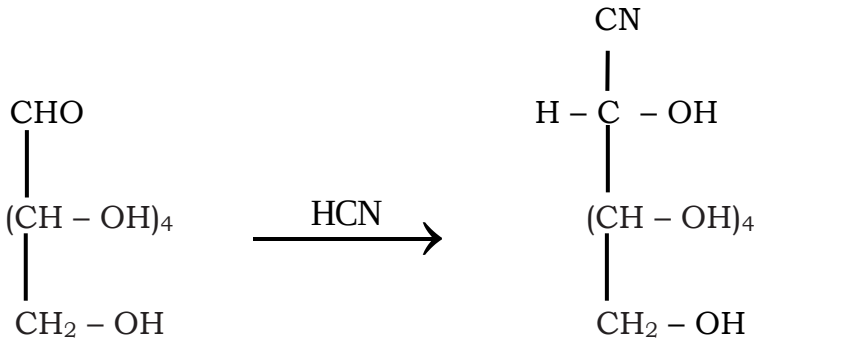
Glucose **Saccharic Acid**

ii.



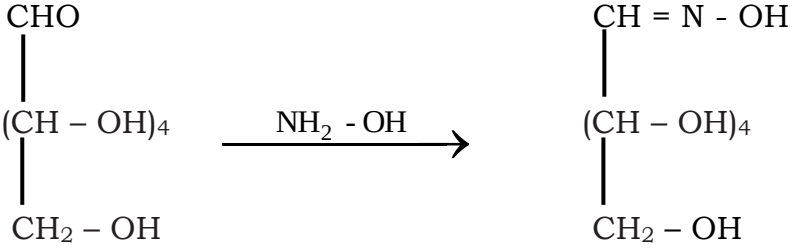
Gluconic Acid **Saccharic acid**

3. Reaction with Hydrogen Cyanide (HCN) :



Glucose **Glucosecyanohydrine**

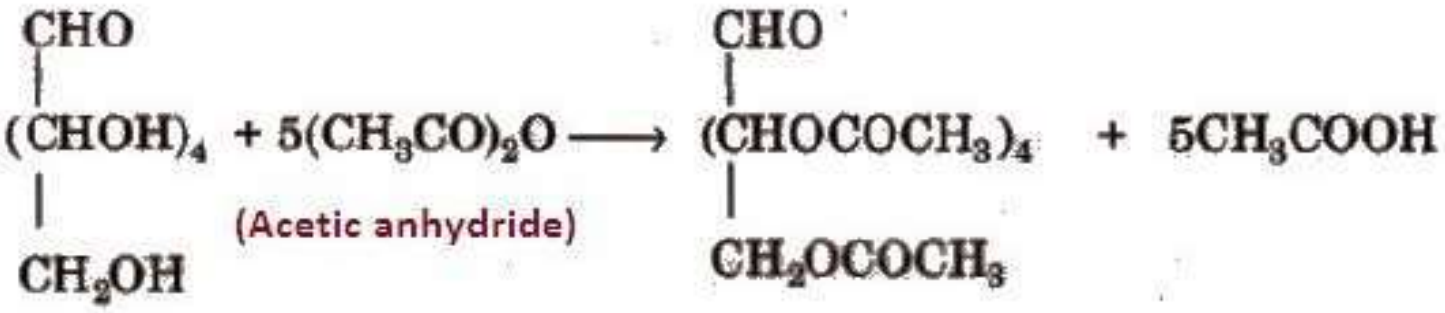
4. Reaction with Hydroxyl amine ($NH_2 – OH$):



Glucose **Glucoxime**

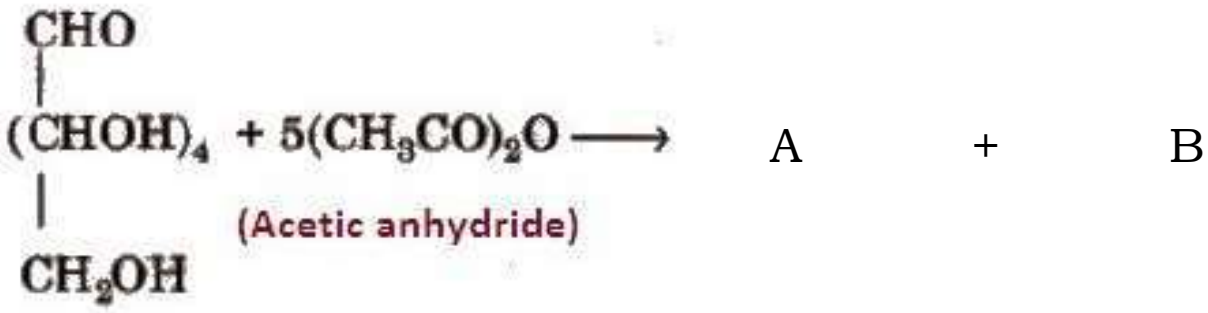
B) Reaction based on Alcoholic group:

5. Reaction with Acetic Anhydride



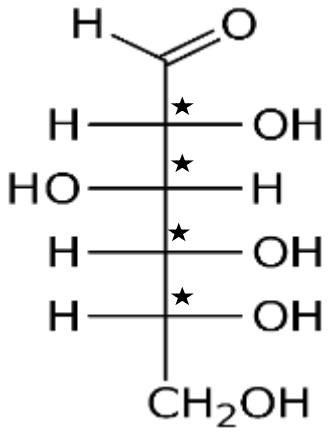
PART – II – EXERCISE – 3: IMPORTANT QUESTION – (EACH QUESTION – 2 Mark)

1. Write the Functional group present in D-(+)-Glucose. (1 M)
2. Write the Fischer projection formula of D-(+)-Glucose. (1 M)
3. How is Glucose prepared from Starch?
4. Write a note on commercial method of preparation of Glucose.
5. How are the following Conversion carried out?
   a) Glucose to n – Hexane
   b) Gluconic acid to Saccharic acid
6. What is the action of following reagents on Glucose?
   a) Br_2 water
   b) Dilute HNO_3
7. What happens when,
   a) Glucose treated with NH_2OH?
   b) Glucose treated with HCN?
8. Identify A and B of the following reaction and rewrite the reaction.



OPTICAL ISOMERISM IN GLUCOSE:

- ***Optical isomersism*** is a form of stereoisomerism in which two compounds contain the same number and kinds of atoms, and bonds (i.e., the connectivity between atoms is the same), and different spatial arrangements of the atoms, but which have non-superimposable mirror images.
- Each non-superimposable mirror image structure is called an enantiomer and phenomenon is known as **enantiomerism.**
- Compounds, molecules or ions that exist as optical isomers are called ***chiral*** because the compound containing optical active carbon (Asymmetric cabron).
- Optical Isomers can be calculated using " $\mathbf{2^n}$ " where n = no of chiral carbon.
- Example : D – (+) – Glucose



No of chiral carbon atom = n = 4

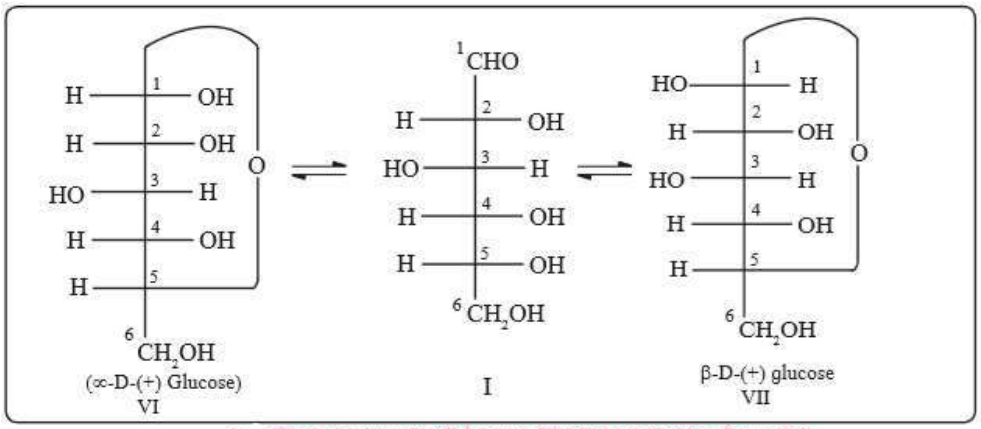
Optical isomers = $2^n = 2^4 = 16$ isomers

- Glucose is an optically active compound and has its specific rotation $[\propto]_D^{20}$ equal to $+52.7^0$, due to its dextrorotation glucose is also called dextrose.

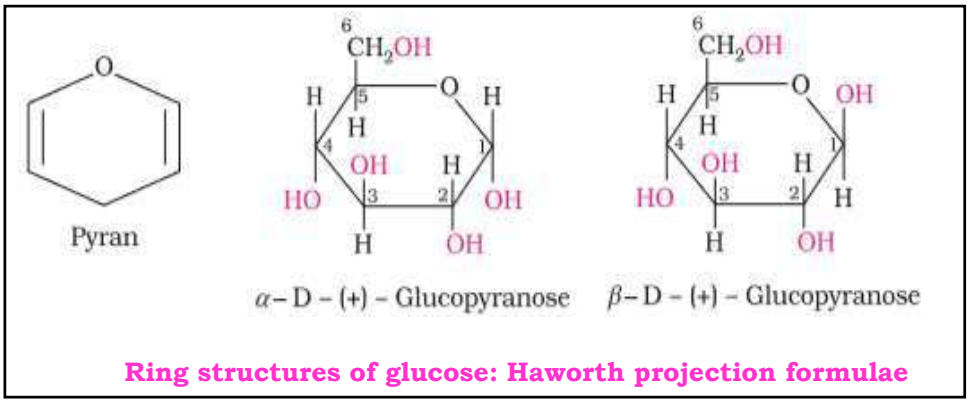
RING/CYCLIC STRUCTURE OF GLUCOSE:

- On the basis of chemical evidence stereo structure of D-(+)-glucose was represented by the Fischer projection formula.
- Glucose, however, was found to exhibit some more chemical properties which could not be explained on the basis of the Fischer projection formula.
- It was necessary to write another structure for glucose which will explain all the properties.
- Ring structure of glucose fulfils this requirement.
- Glucose is found to have two cyclic structures which are in equilibrium with each other through the open chain structure (Fischer projection formula) in aqueous solution.

- A ***Haworth projection*** is a common way of writing a structural formula to represent the cyclic structure of monosaccharides with a simple three-dimensional perspective.
- The ring structure of glucose is formed by reaction between the formyl (-CHO) group and the alcoholic (-OH) group at C-5. Thus, the ring structure is a hemiacetal structure.
- The two hemiacetal structures differ only in the configuration of C-1 , the additional chiral centre resulting from ring closure.
- The two ring structures are called **∝-anomers** and **β- anomers** of glucose and C-1 is called the anomeric carbon.
- The ***anomeric carbon*** is the carbon derived from the carbonyl carbon compound (the ketone or aldehyde functional group) of the open-chain form of the carbohydrate molecule.
- The ring of the cyclic structure of glucose contains five carbons and one oxygen. Thus, it is a six membered ring. It is called pyranose structure, in analogy with the six membered heterocyclic compound pyran. Hence glucose is also called glucopyranose.
- The groups which appear on right side in the Fischer projection formula appear on α-side in the Haworth formula, and viceversa.



Ring structures of glucose: Fischer projection formulae



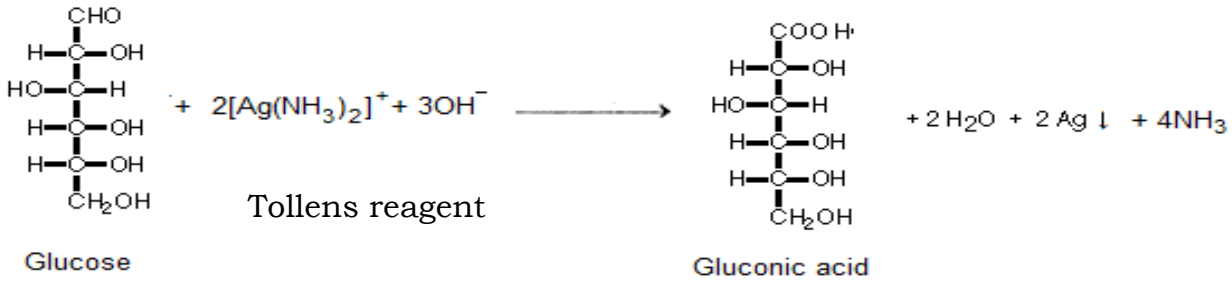
Ring structures of glucose: Haworth projection formulae

REDUCING NATURE OF GLUCOSE:

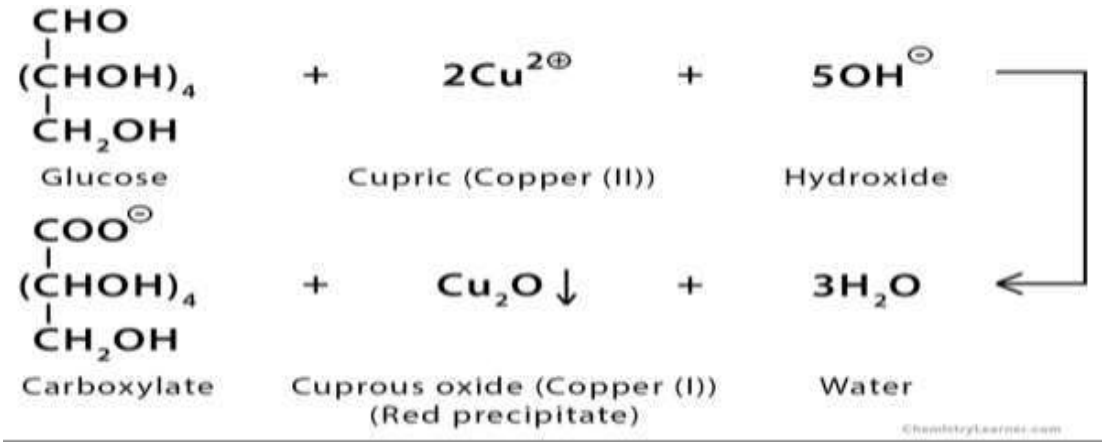
- Hemiacetal group of glucopyranose structure is a potential aldehyde group.
- It imparts reducing properties to glucose.
- Glucose gives positive Tollens test and positive Fehling test

NOTE:

a) Tollens Test/Silver mirror test:



b) Fehling test:



c) Benedict's test:

Glucose + Benedict's reagent ($CuSO_4$ +Na_2CO_3 + Sodium citrate)

↓

Brown/Orange precipitate

d) Barfoed's test:

Glucose + Barfoed's reagent ($CuSO_4$ + Acetic acid)

↓

A scanty brick red precipitate

e) Molisch's test:

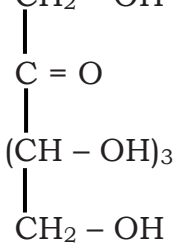
Glucose + Molisch's reagent (α – naphthol + con. H_2SO_4)

↓

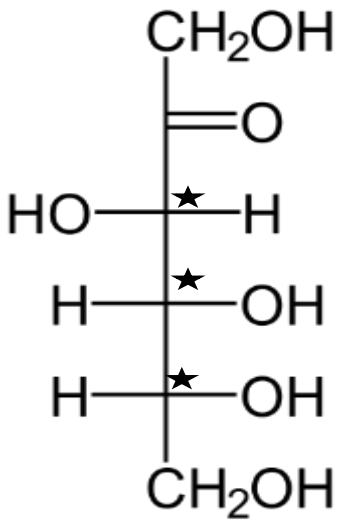
Reddish violet / Purple colour

REPRESENTATION OF FRUCTOSE STRUCTURE:

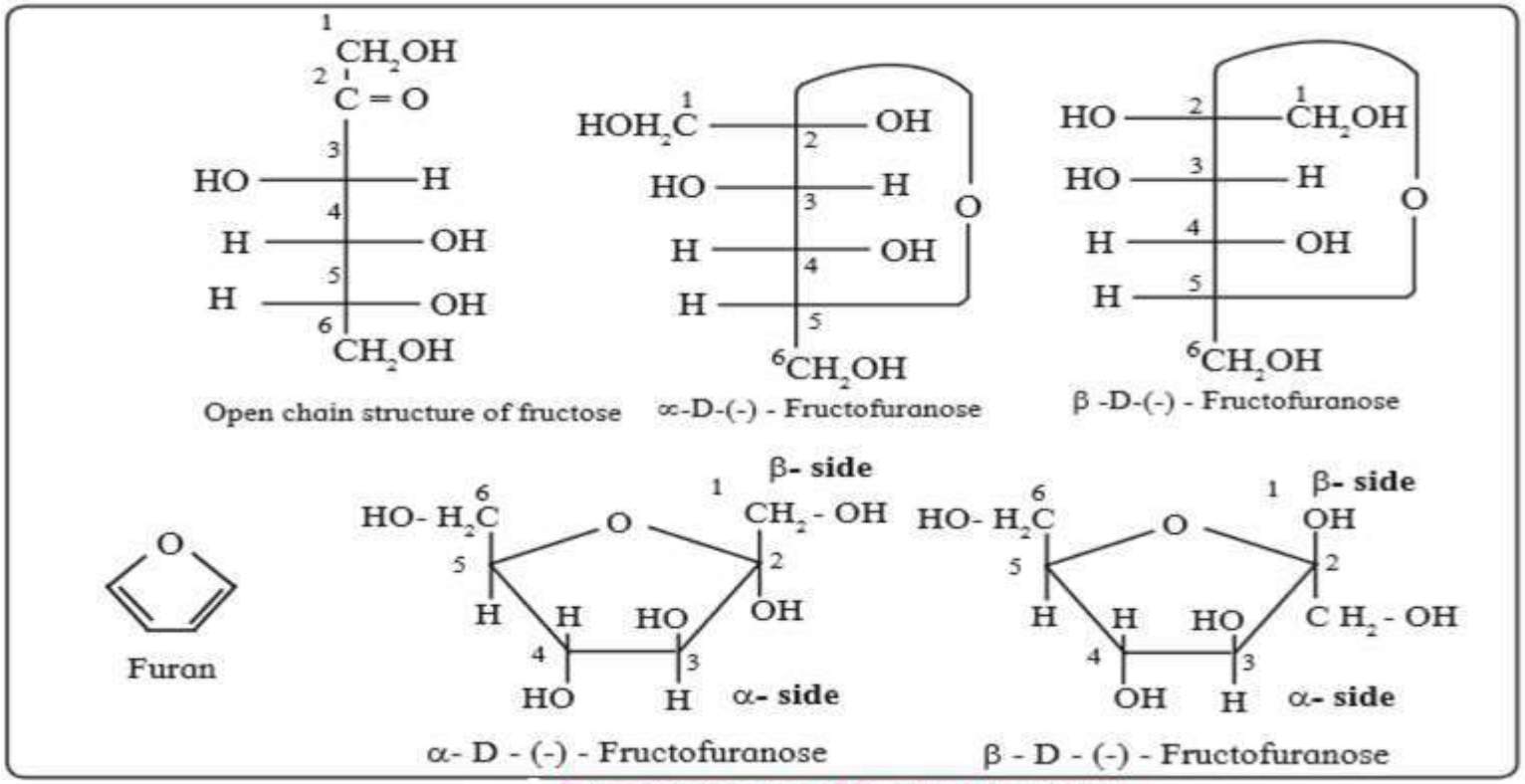
- Fructose is a optically active pentahydroxy ketone contain 3 chiral carbon atom.
- Molecular formula : $C_6H_{12}O_6$
- Structural formula :



- NOTE: 2 – Primary Alcoholic group (– CH_2 – OH) and 3 – Secondary alcoholic group (>CH – OH)
- Fischer projection formula: D – (–) – Fructose



- NOTE: 3 – Chiral carbon atom, Optical isomers = $2^3 = 2^3 = 8$
- Fructose is an optically active compound and has its specific rotation, $[\propto]_D^{20}$, equal to – 92.4^0, due to its laevorotation fructose is also called laevulose.
- In Free State it exists as mixture of fructopyranose (major) and fructofuranose.
- In combined state fructose is found in the form of fructofuranose ring structure.
- The name furanose is given by analogy with furan, a five membered heterocyclic compound.
- The open chain structure of fructose contain keto group and ring structures of ∝- and β-anomers of fructofuranose contain hemiketal as a functional group.



Representations of fructose structure

REDUCING NATURE OF FRUCTOSE:

- Hemiketal group of fructofuranose structure is a potential ketone group.
- It imparts reducing properties to Fructose.
- Tollen's test, Fehling's test, Benedict's test, Barfoed's test, Molisch's test can easily shows reducing nature of fructose.

DISACCHARIDES:

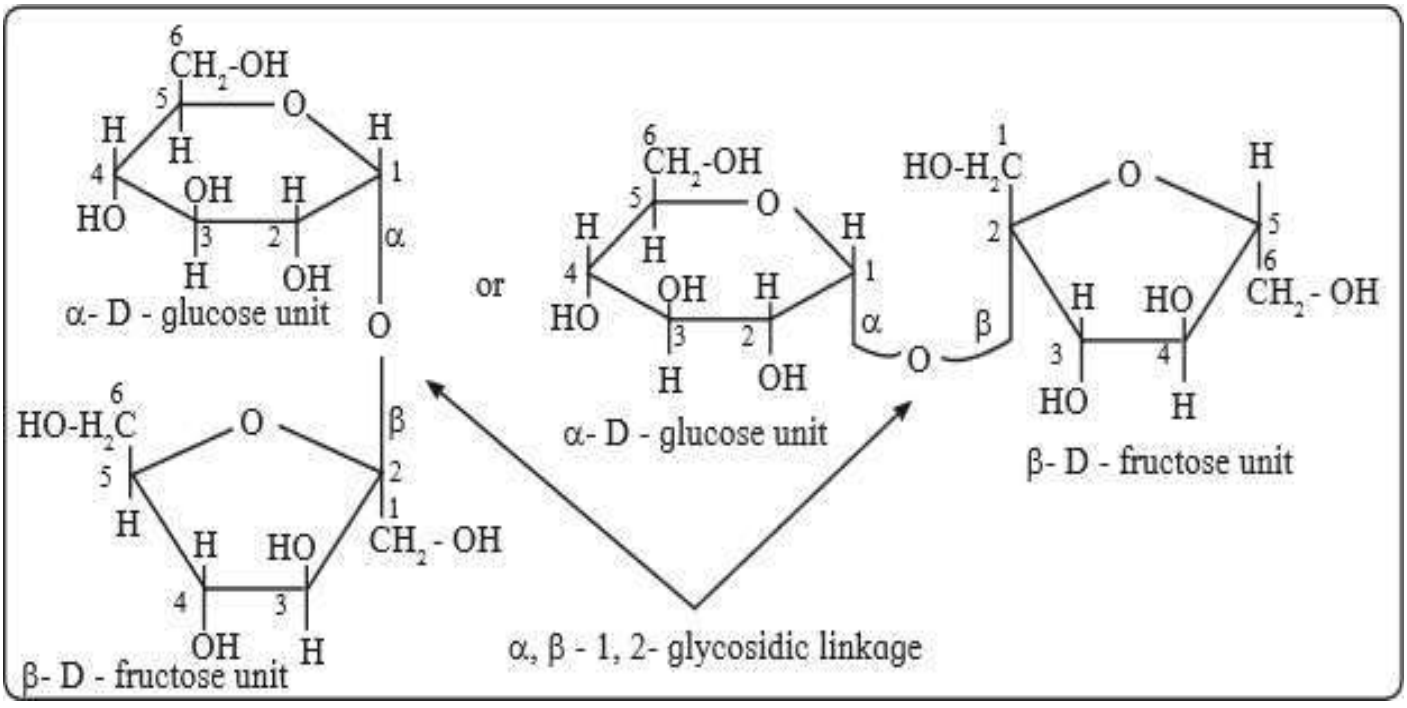
- Disaccharides give rise to two units of same or different monosaccharides on hydrolysis with dilute acids or specific enzymes.
- The two monosaccharide units are linked together by an ether oxide linkage (-O-), which is termed as glycosidic linkage in carbohydrate.
- Glycosidic linkage is formed by removal of a water molecule by reaction of two hydroxyl (-OH) groups from two monosaccharide units.
- At least one of the two monosaccharide units must use its anomeric hydroxyl group in formation of the glycosidic linkage.
- Three most common disaccharides are sucrose, maltose and lactose.

1. SUCROSE: [Enzyme used for hydrolysis is Invertase]

- Sucrose is a formation of C – 1 carbon of α – D – (+) – Glucopyranose and C – 2 carbon of β – D – (–) – Fructofuranose through gylcosidic linkage (ether linkage).
- It is obtained from Cane sugar.
- Sucrose ($C_{12}H_{22}O_{11}$) is dextrorotatory (+66.50). On hydrolysis with dilute acid or an enzyme called invertase sucrose gives equimolar mixture of D-(+) glucose and D-(-) fructose.

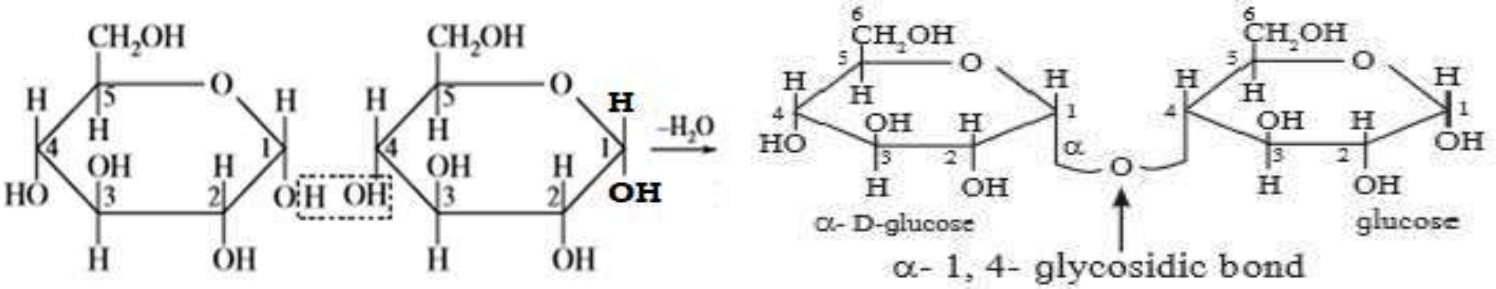
$$\underset{C_{12}H_{22}O_{11}}{\text{Sucrose}} \xrightarrow[H_2O]{\text{Hydrolysis}} \underset{\substack{C_6H_{12}O_6 \\ \text{D – (+) – Glucose}}}{\text{Glucose}} + \underset{\substack{C_6H_{12}O_6 \\ \text{D – (–) – Fructose}}}{\text{Fructose}}$$

- Since the laevoratotion of fructose (-92.40) is larger than the dextrorotation of glucose (+52.70), the hydrolysis product has net laevorotation. Hence hydrolysis of sucrose is also called inversion of sucrose and the product is called **invert sugar.**
- The potential aldehyde and ketone groups of both the monosaccharide units are involved in formation of the glycosidic bond, **sucrose is a non- reducing sugar**.
- Sucrose is Soluble in water and sweet in taste.
- Sucrose gives negative Tollen's test.
- Sucrose gives negative Fehling's test.



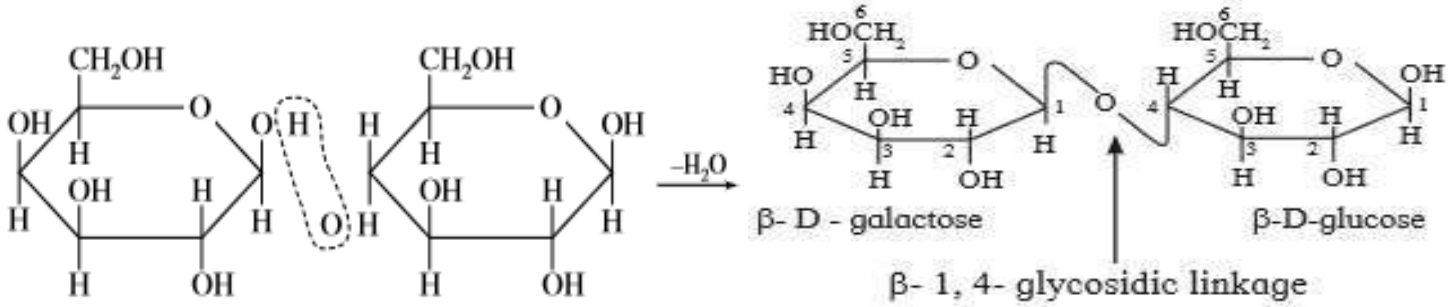
2. MALTOSE: [Enzyme used for hydrolysis is Maltase]

- Maltose ($C_{12}H_{22}O_{11}$) is the formation of C – 1 carbon of α – D – (+) – Glucopyranose and C – 4 carbon of α – D – (+) – Glucopyranose of another molecule through gylcosidic linkage (ether linkage).
- It is obtained from partial hydrolysis of starch.
- It is also known as malt sugar.
- The hemiacetal group at C-1 of the second ring is not involved in glycosidic linkage. Hence maltose is a **reducing sugar**.
- Maltose gives positive Tollen's test.
- Maltose gives positive Fehling's test.



3. LACTOSE: [Enzyme used for hydrolysis is Lactase]

- Lactose ($C_{12}H_{22}O_{11}$) is the formation of C – 1 carbon of β – D – (+) – Galactopyranose and C – 4 carbon of β – D – (+) – Glucopyranose of another molecule through gylcosidic linkage (ether linkage).
- It is obtained from Milk.
- It is also known as Milk sugar.
- The hemiacetal group at C-1 of the second ring is not involved in glycosidic linkage. Hence lactose is a **reducing sugar**.
- Lactose gives positive Tollen's test.
- Lactose gives positive Fehling's test.



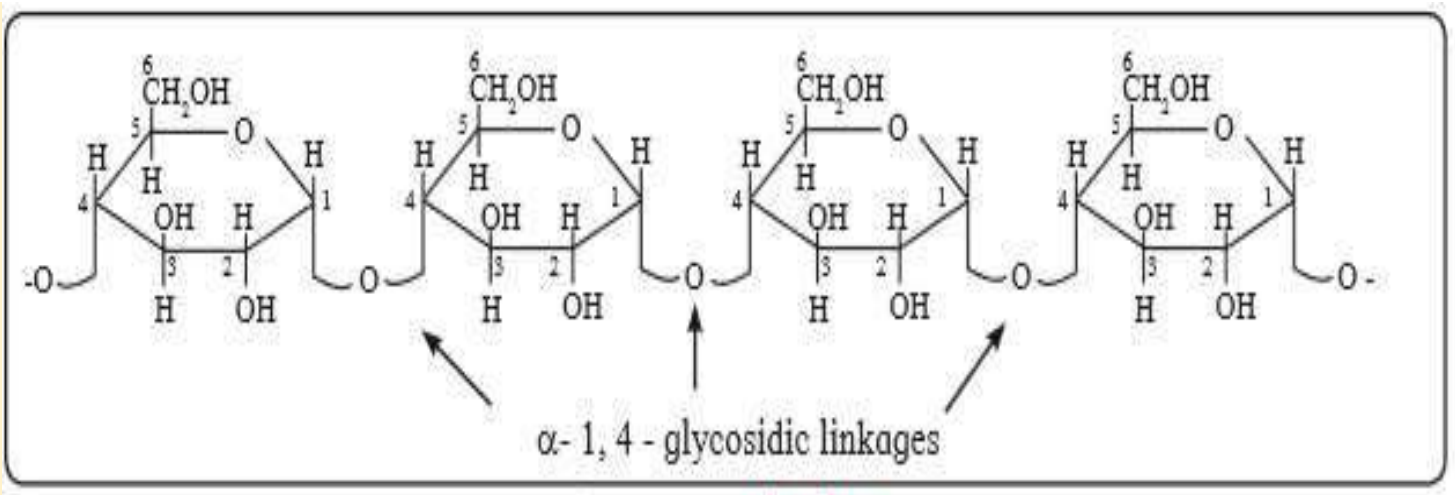
POLYSACCHARIDES:

- Polysaccharides are formed by linking large number of monosaccharide units by glycosidic linkages.
- These are linear polymers and also highly branched polymers.
- These are not called as sugar because are not sweet in taste Except Insulin which is sweet.
- Starch, cellulose and glycogen are the most common natural polysaccharides.

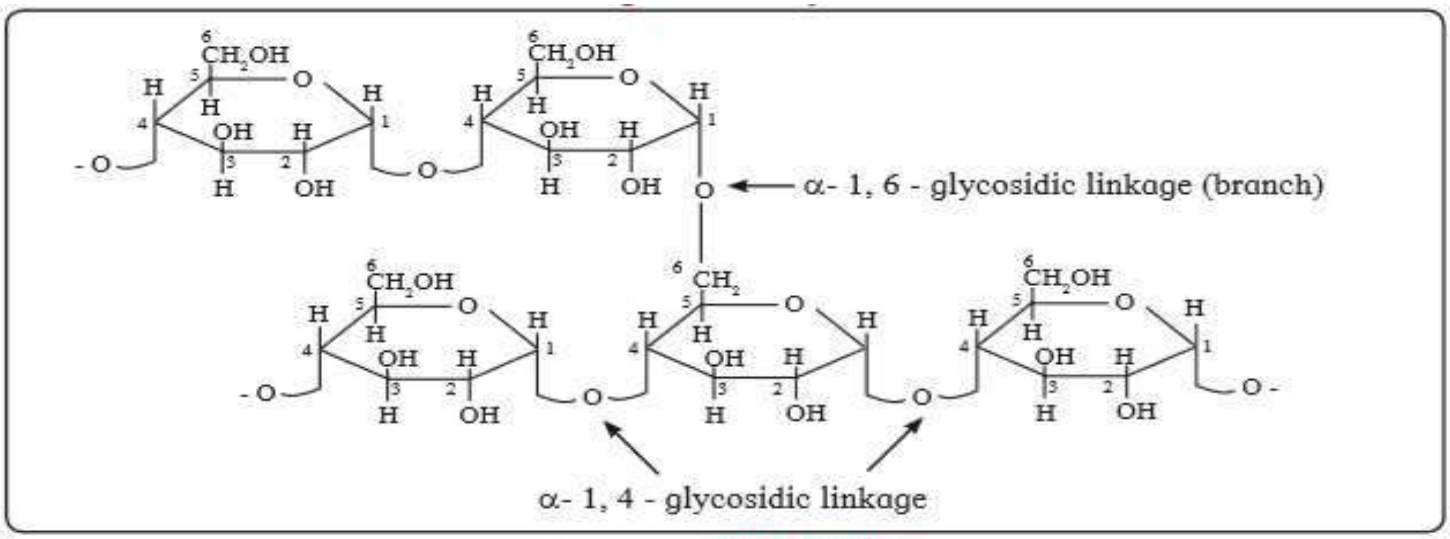
1. STARCH: [$(C_6H_{10}O_5)_n$ – Enzyme used for hydrolysis is Amylase]

- Starch is storage carbohydrate of plants and important nutrient for humans and other animals.
- Starch is a polymer of ∝-D-glucose.
- Starch has two components, namely, amylose (15-20%) and amylopectin (80-85%).

No	Amylose	Amylopectin
1	It contains 15-20% of starch.	It contains 80-85 % of starch.
2	It is soluble in water.	It is insoluble in water.
3	It is unbranched helical structure	It is a branched chain structure.
4	It contains 200-1000 ∝-glucose units linked by ∝-1,4- glycosidic linkages	The chains are formed by ∝-1,4- glycosidic linkages between ∝-glucose units, whereas branches (Branch of 24–30 glucose monomers) are formed by ∝-1,6- glycosidic linkages
5	It gives blue colour with I_2.	It gives blue-violet colour with I_2.



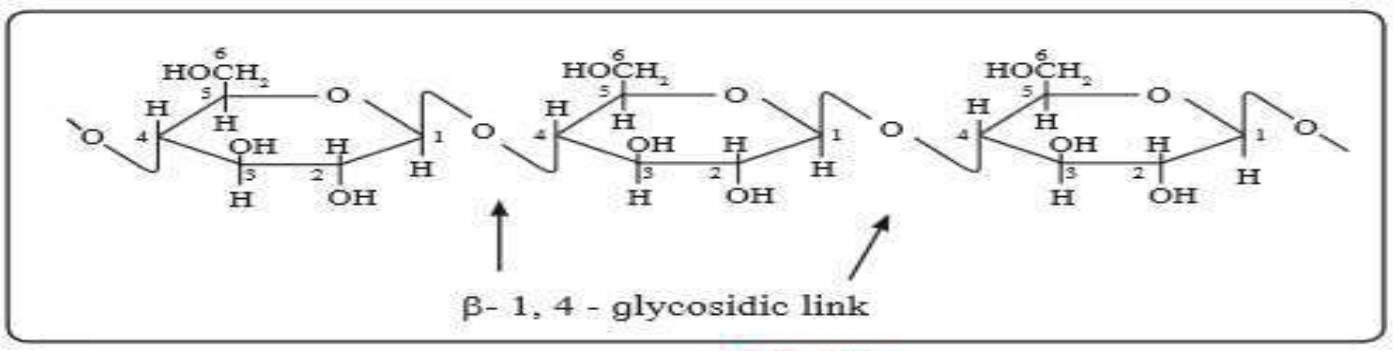
Amylose



Amylopectin

2. CELLULOSE: [$(C_6H_{10}O_5)_n$ – Enzyme used for hydrolysis is Cellulase]

- Cellulose is the main constituent of cell wall of plant and bacterial cells.
- It is also main constituent of wood and cotton.
- It is insoluble in water,
- Cellulose is a straight chain polysaccharide of β-glucose units linked by β-1, 4 – glycosidic bonds.
- Chemical hydrolysis of cellulose requires use of concentrated strong acids at high temperature and pressure.
- This implies that the β-1,4- glycosidic bond is very strong and difficult to hydrolyze.
- Humans do not have enzymes which can hydrolyze this linkage. Hence cellulose cannot be digested by human beings; it serves as the fibrous content of food useful for bowel movement.
- It does not give colour with I_2.



Cellulose

3. GLYCOGEN : [$(C_6H_{10}O_5)_n$]

- Glycogen constitutes storage carbohydrate of animals and is present in liver, muscles and brain.
- It is also found in yeast and fungi.
- Glycogen has its structure similar to that of amylopectin, but it is more highly branched.
- It gives red colour with I_2.

PART – II – EXERCISE – 4 : IMPORTANT QUESTION – (EACH QUESTION – 2/3 Mark)

1. Explain optical isomerism in Glucose.
2. Write Fischer projection formula of α – D – (+) – Glucopyranose and β – D – (-) – Glucopyranose.
3. Write Haworth projection formula of α – D – (+) – Glucopyranose and β – D – (-) – Glucopyranose.
4. Write Fischer projection formula of α – D – (-) – Fructofuranose and β – D – (-) – Fructofuranose.
5. Write Haworth projection formula of α – D –(-)– Fructofuranose and β – D –(-)– Fructofuranose.
6. Explain reducing nature of Glucose.
7. Write a short note on Sucrose.
8. Write a short note on Maltose.
9. Write a short note on Lactose.
10. Write a short note on Starch.
11. Write a short note on Cellulose.
12. Write distinguish between Amylose and Amylopectin.
13. Write the structure of following compounds.
    a) Sucrose
    b) Lactose
    c) Maltose

SOME IMPORTANT POINTS TO REMEMBER FOR MULTIPLE CHOICE QUESTIONS

1. Monosaccharide's and Oligosaccharides are water soluble , sweet in taste and reducing in nature (due to presence of aldehyde, ketone, hemiacetal and hemiketal group) except sucrose which is non – reducing in nature.
2. Polysaccharides do not have sweet test (except insulin) and are non – reducing in nature.(due to absence of aldehyde, ketone, hemiacetal and hemiketal group)

Name of test	Glucose	Fructose	Sucrose	Maltose	Lactose	Starch	Cellulose	Glycogen
Tollens Test	Positive	Positive	Negative	Positive	Positive	Negative	Negative	Negative
Fehling Test	Positive	Positive	Negative	Positive	Positive	Negative	Negative	Negative
Benedict's test	Positive	Positive	Negative	Positive	Positive	Negative	Negative	Negative
Barfoed's test:	Positive	Positive	Negative	Negative	Negative	Negative	Negative	Negative
Molisch's test:	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Iodine test	----------	----------	----------	----------	----------	Positive	Negative	Positive

PART: III – PROTEINS:

INTRODUCTION

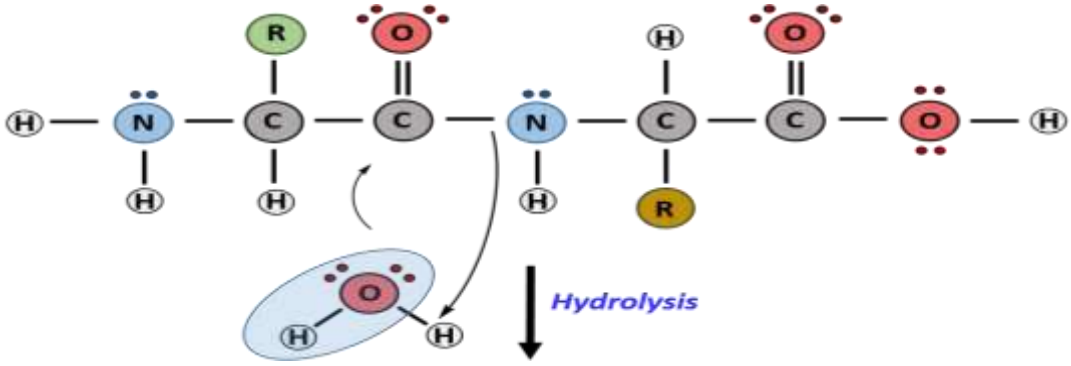
1. It is a naturally occurring biomolecules.
2. The term protein is derived from Greek word 'Proteios' means "Of prime importance".
3. The chief sources of proteins are cereals of grain, cheese, pluses, peanuts, egg, fish, meat & must for balanced diet.
4. It is found in living cells & are present in hair, skin, muscles, nerves, enzymes, antibodies, hormones etc.
5. Proteins contains C,H,O,N,S,P & other elements such as Co,Fe,Mg,Cu,Zn.

DEFINITION OF PROTEINS

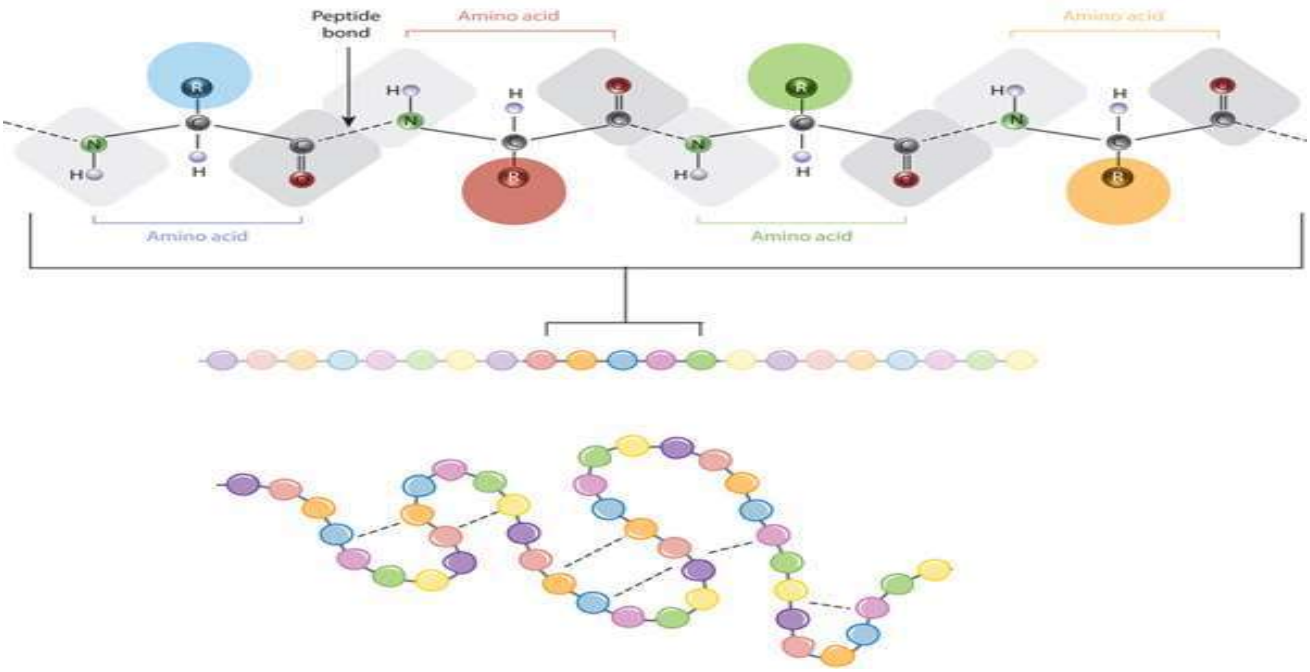
Proteins are higher molecular weight biopolymer containing nitrogenous compound and on hydrolysis yields ∝ – amino acid.

OR

Proteins are polyamides having high molecular weight polymers of the monomer units called ∝-amino acids.

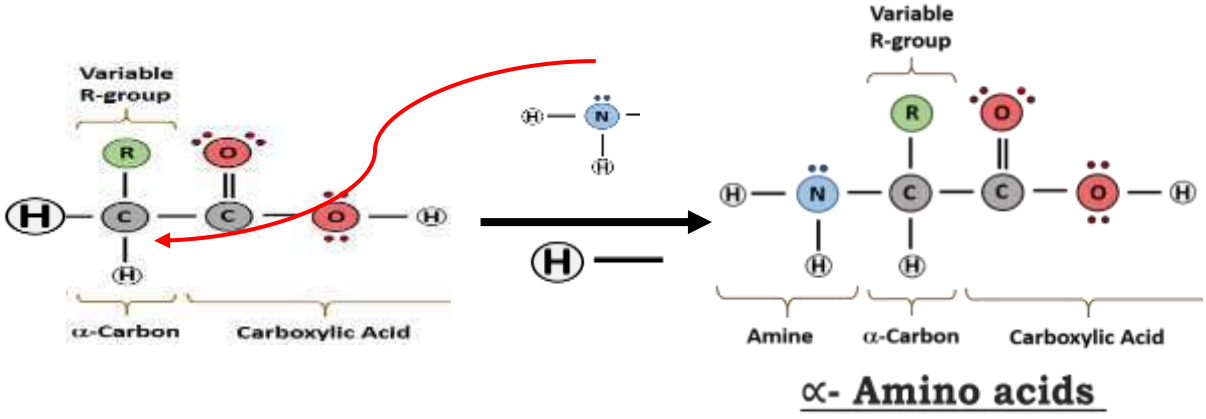


Structural Representation of Proteins

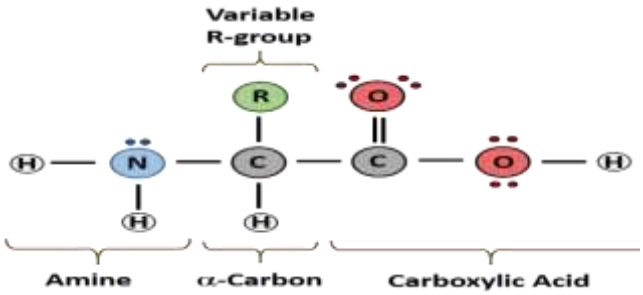


∝- AMINO ACIDS

∝ - amino acid are derivatives of carboxylic acids obtained by replacing ∝ - hydrogen atom by amino group.

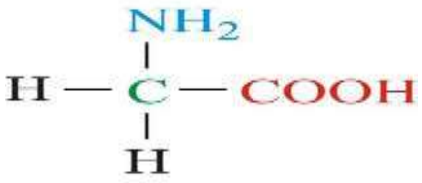


- General representation of ∝ - amino acids:



- Where 'R' in the structure of ∝ - amino acids represents side chain and may contain additional functional groups.

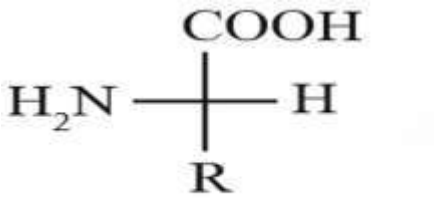
- ∝ - carbon in all ∝ - amino acids is chiral in nature. (Except glycine).



Note:

Proteins on hydrolysis give about 30 amino acids, out of 20 amino acids are most common.

- It is found that the ∝- carbon in ∝-amino acids obtained by hydrolysis of proteins has 'L' configuration.
- The L-∝ - amino acids are represented by the Fischer projection formula.



L-∝-amino acid

CLASSIFICATION OF ∝- AMINO ACIDS

A. On the basis of Side chain (Based on Nature)

1. **Acidic amino acid:**
   If 'R' contains a carboxyl (-COOH) group the amino acid is acidic amino acid.
   OR
   If amino group are less than carboxylic group than the amino acid is acidic in nature.

   Example: Glutamic acid, Aspartic acid (GA)

2. **Basic amino acid:**
   If 'R' contains an amino (1^0,2^0 or 3^0) group, the amino acid is Basic amino acid.
   OR
   If amino group are more than carboxylic group than the amino acid is Basic in nature.

   Example: Histidine, Arginine, Lysine (HAL)

3. **Neutral amino acid:**
   If 'R' do not contains any functional group, the amino acid is Neutral amino acid.

   OR

   If amino group and carboxylic group are equal in number than the amino acid is neutral in nature.

   Example: Glycine, Alanine, Valine (GAV)

B. On the basis of Synthesis:

1. Essential amino acids:

The amino acids which do not synthesize in body and are supplied through diet are called Essential amino acids.

Example: Lysine, Valine

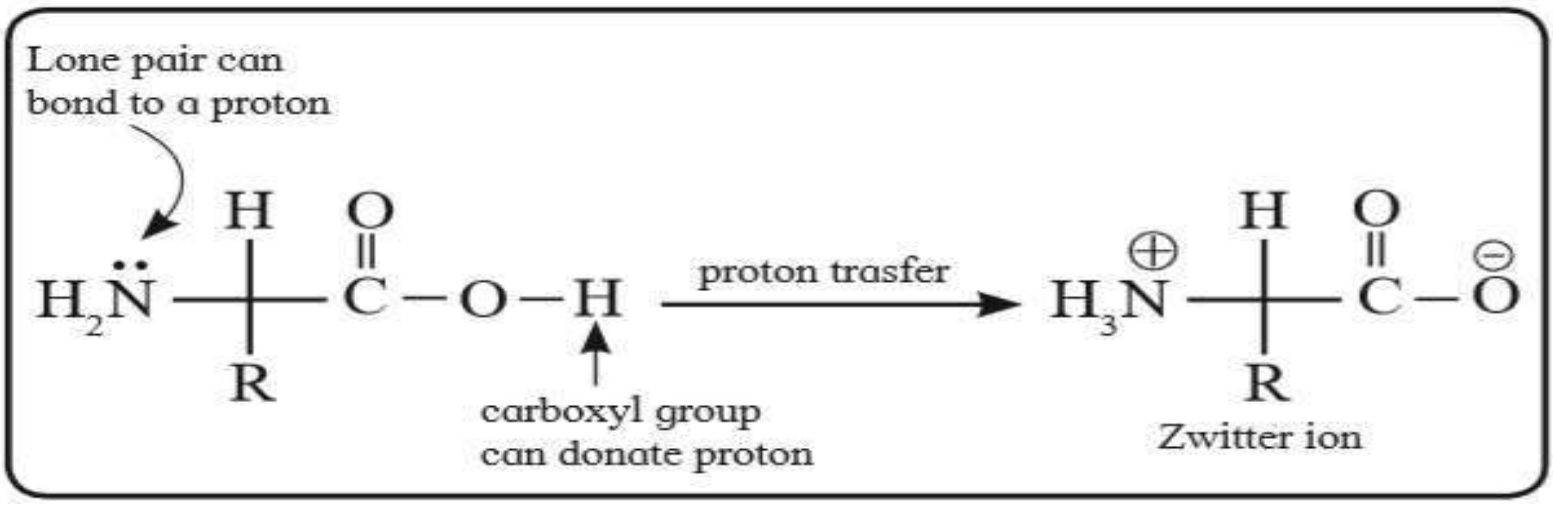
2. **Non – Essential amino acids:**

The amino acids which are synthesize in body are called Non - essential amino acids.

Example: Glutamic acid, Serine.

Explain Zwitter ion.

- ∝ - amino acids are crystalline, colorless, water soluble, non – volatile, high melting point solid.
- ∝ - amino acids in their aqueous solutions forms salt due to presence of both acidic carboxyl group (-COOH) as well as basic amino group ($-NH_2$) in same molecule.
- Such **Dipolar ion** called as Zwitter ion.



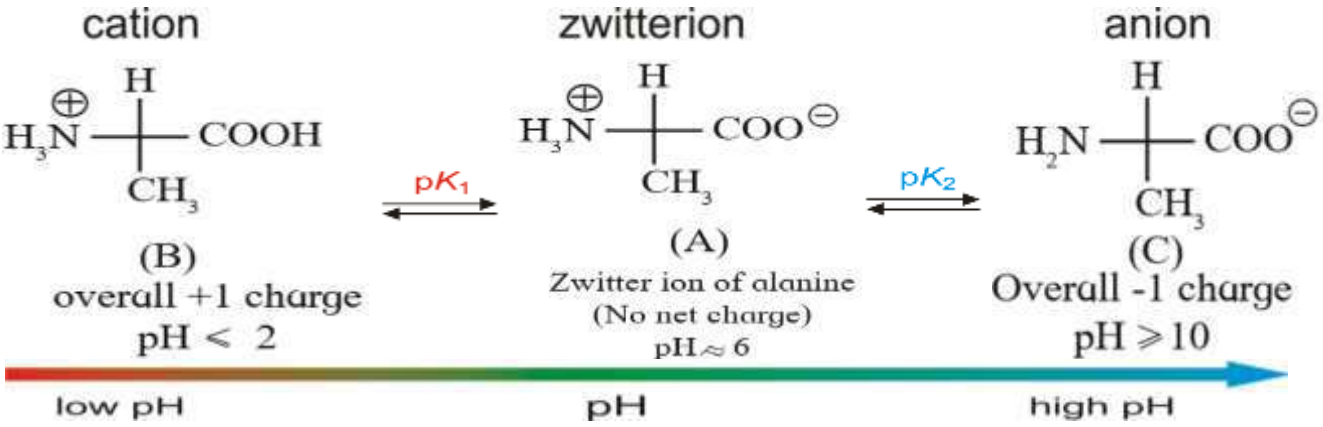
NOTE: - 1

∝ - amino acids have high melting points compared to the corresponding amines or carboxylic acids of comparable molecular mass because the peculiar structure called zwitter ion structure of ∝ - amino acids formed when it dissolved in water.

Formula	Molecular mass	Melting point
$CH_3 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - COOH$	89	293.5°C
$C_5H_{11} - NH_2$	87	-55°C
$C_3H_7 - COOH$	88	-7.9°C

NOTE : - 2

∝ - Amino acid can exist in different forms depending upon the pH of the aqueous solution in which it is dissolved.



Amino acids are the building blocks for proteins.

Proteins $\longrightarrow$ α - Amino acids

Proteins $\longrightarrow$ Polypeptides $\longrightarrow$ α - Amino acids

- ✓ Proteins are polypeptides having *more than 100 amino acid* residues linked by peptide bonds.
- ✓ Polypeptides are formed when more than 10 amino acids linked by peptide bonds.
- ✓ ∝ - amino acids are the simplest form of monomer used to prepare Polypeptide chain and Proteins.

Definition of Peptide bond/Peptide linkage

The bond that connects ∝ - amino acids to each other is called peptide bond.

Explanation:

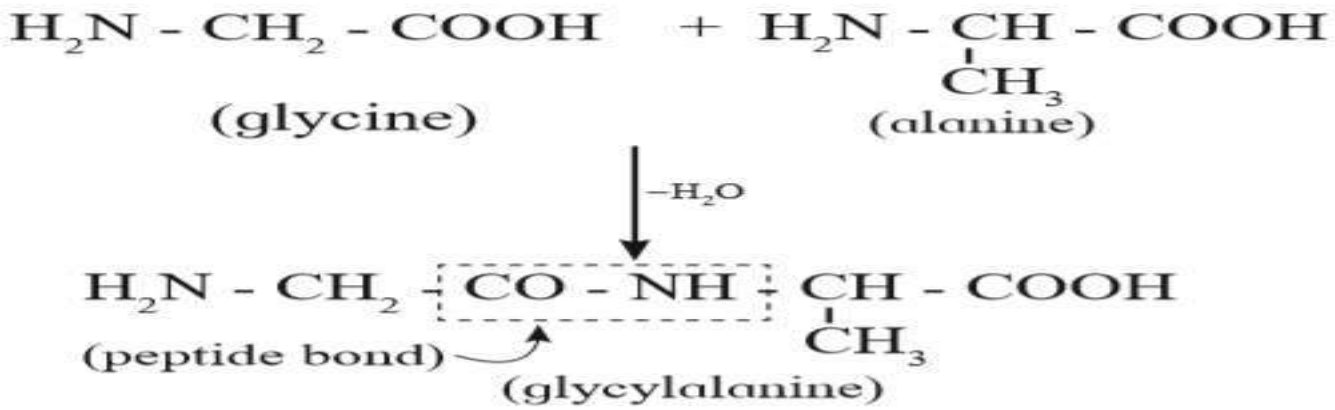
When Amino acids are joined together by peptide bonds, in which the amino group

(– NH_2) of one amino acid bonds to the carboxyl group (–COOH) group of another amino acid.

Note:

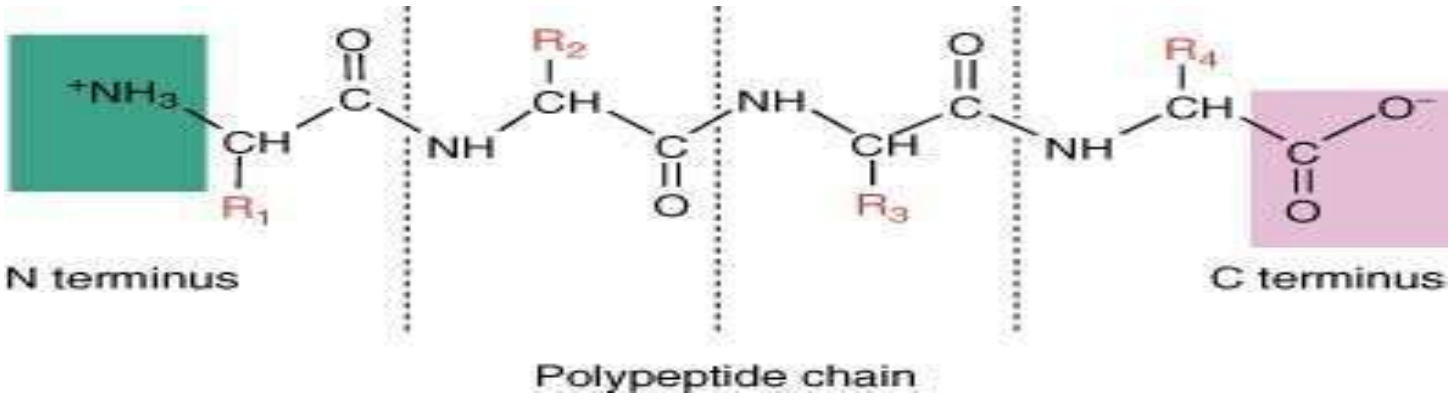
Peptide linkage is same as secondary amide. (–CONH –).

Example:



Explain Polypeptide

- The number of α – amino acids linked by peptide bonds is more than ten, the products are called polypeptides.
- The – CHR – units linked by peptide bond are referred to as 'amino acid residues'.
- The two ends of polypeptide chain of protein are not identical.
- The end having free carboxyl group is called **C – terminal** while the other end having free amino group is called **N –terminal.**



TYPES OF PROTEINS

Depending upon the molecular shape proteins are classified into two types.

a. **Fibrous proteins :**

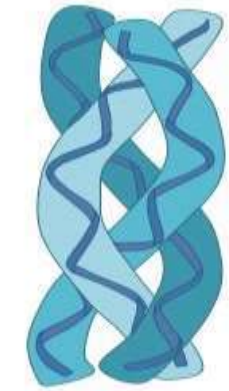
- The proteins in which polypeptide chains lie parallel to each other to form a thread like or rod like structure called Fibrous protein.
- The chains are held together by Hydrogen bonds & Disulfide bonds.
- The proteins are tough and insoluble in water, dil. acid, base, alcohol.
- Examples:

K	Keratin	Hair, Skin , Nails, Horn , Feathers
F	Fibroin	Silk
C	Collagen	Tendons
Meal	Myosin	Muscles

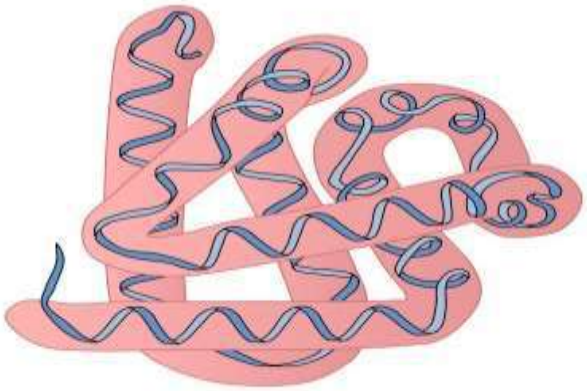
b. **Globular proteins :**

- The proteins in which polypeptide chains are folded to form spherical or coil like structure called Globular protein.
- The chains are held together by intramolecular Hydrogen bonding.
- The proteins are soft and soluble in water, dil. acid , base, alcohol.
- Examples:

H	Haemoglobin	From Blood
A	Albumin	From Egg
T	Thyroglobulin	From Thyroid gland
I	Insulin	From Pancreas



Fibrous Protein



Globular Protein

Note:

The shapes of protein molecules (Fibrous and globular) are the result of four level structure of proteins.

STRUCTURE OF PROTEINS

1. **Primary structure of protein:**

- Primary structure of proteins is the simple sequence of constituent ∝-amino acid residues linked by peptide bonds.
- Primary structure of proteins is represented by writing the three letter symbols of amino acid residues as per their sequence in the concerned protein.
- The symbols are separated by dashes.

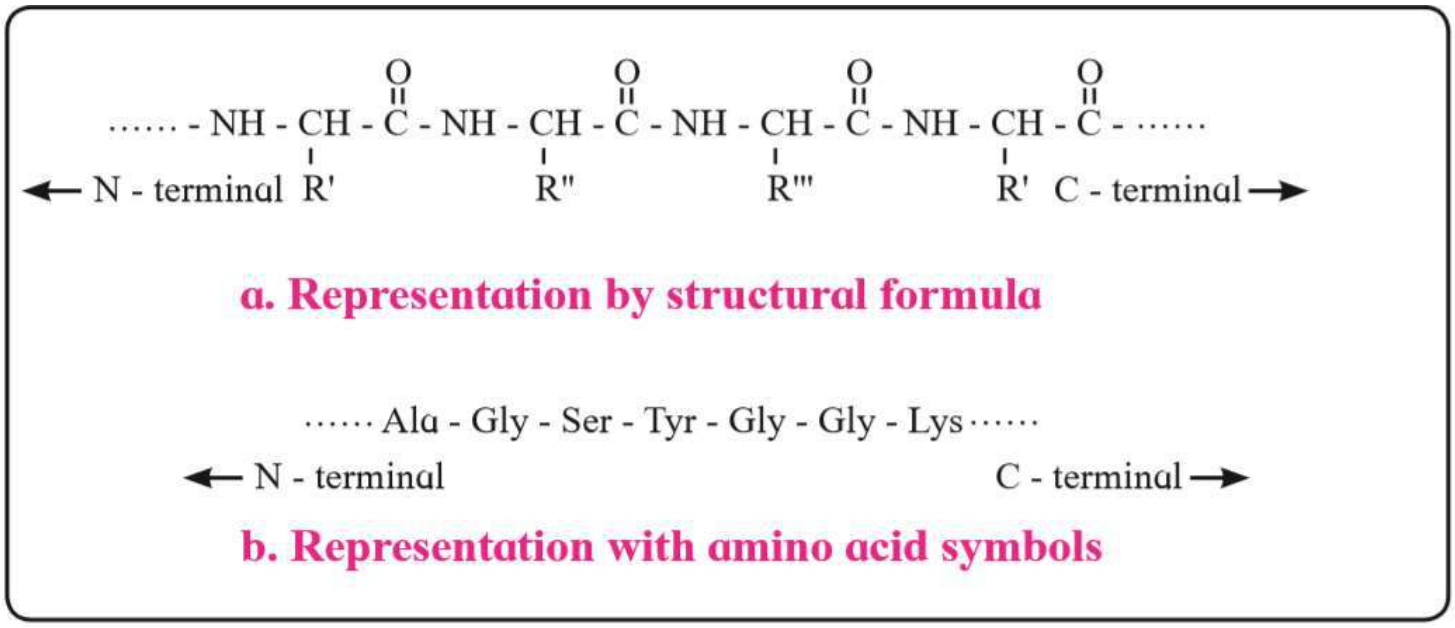
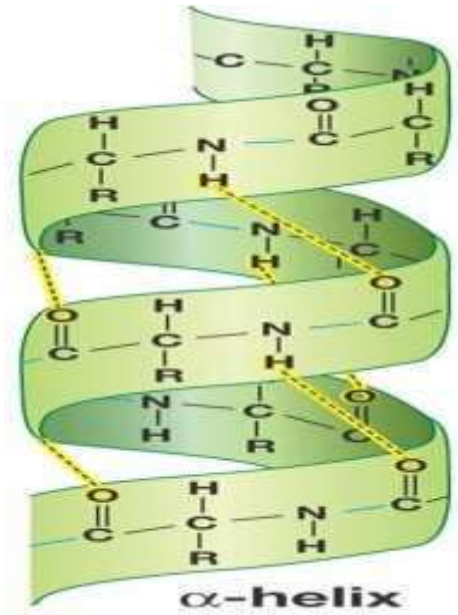


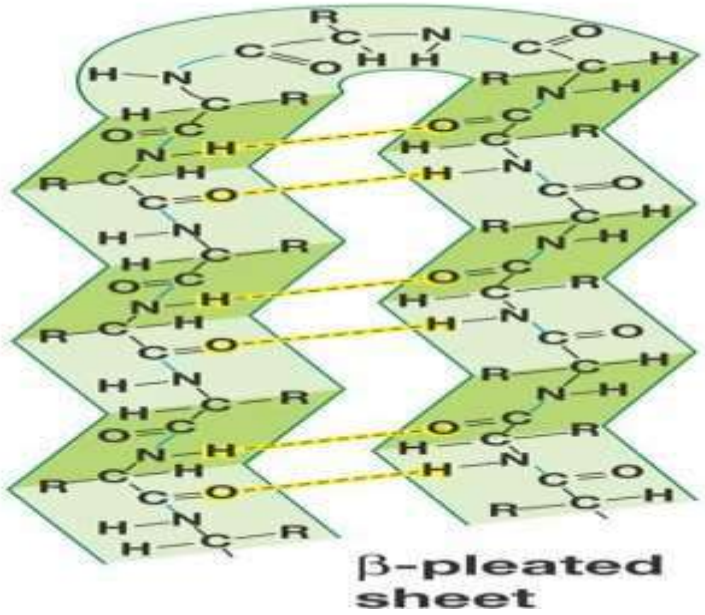
Fig. 14.18 : Representation of primary structure of protein

2. Secondary structure of protein:

- The three-dimensional arrangement of localized regions of a protein chain is called the secondary structure of protein.
- Hydrogen bonding between N-H proton of one amide linkage and C=O oxygen of another gives rise to the secondary structure.
- The secondary structure of protein refers to the shape in which a long polypeptide chain can exist.
- Two types of secondary structures commonly found in proteins are ∝-helix and β-pleated sheet.

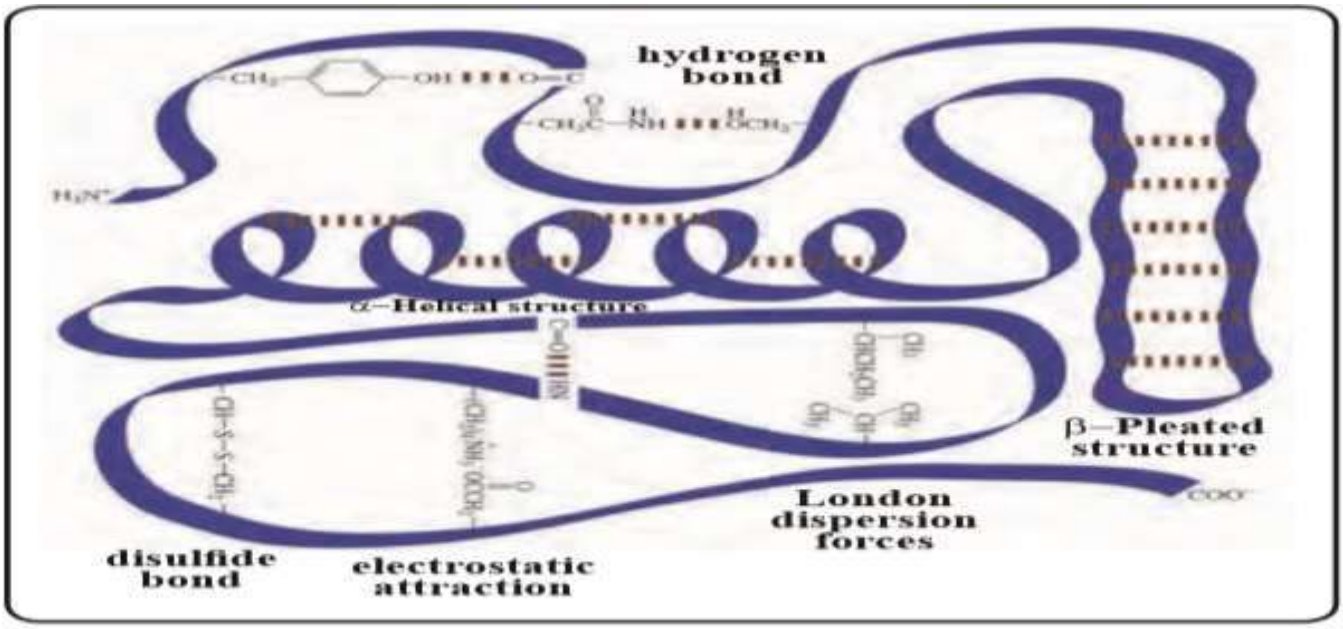
∝-helix	β-pleated sheet.
The ∝-helix forms when a polypeptide chain twists into a right handed or clockwise spiral.	The β – pleated sheet forms when a polypeptide chains lie parallel side by side.
The chain is held together by Intramolecular hydrogen bonding.	The chains are held together by Intermolecular hydrogen bonding.
A C=O group of one amino acid is hydrogen bonded to N-H group of the fourth amino acid along the chain.	Hydrogen bonding occurs between the N-H and C=O groups of nearby amino acid residues in the neighboring chains.





3. Tertiary structure of protein:

- The three-dimensional shape adopted by the entire polypeptide chain of a protein is called its tertiary structure.
- It is the result of folding of the chain in a particular manner that the structure is itself stabilized and also has attractive interaction with the aqueous environment of the cell.
- The globular and fibrous proteins represent two major molecular shapes resulting from the tertiary structure.
- The forces that stabilize a particular tertiary structure include hydrogen bonding, dipole dipole attraction (due to polar bonds in the side chains), electrostatic attraction (due to the ionic groups like $-COO^-$, $NH_3^{\oplus}$ in the side chain), London dispersion forces & disulfide bond.



4. Quaternary structure of protein:

- When two or more polypeptide chains with folded tertiary structures come together into one protein complex, the resulting shape is called quaternary structure of the protein.
- For example: Haemoglobin consists of four subunits called haeme held together by intermolecular forces in a compact three dimensional shape.
- Haemoglobin can do its function of oxygen transport only when all the four subunits are together.

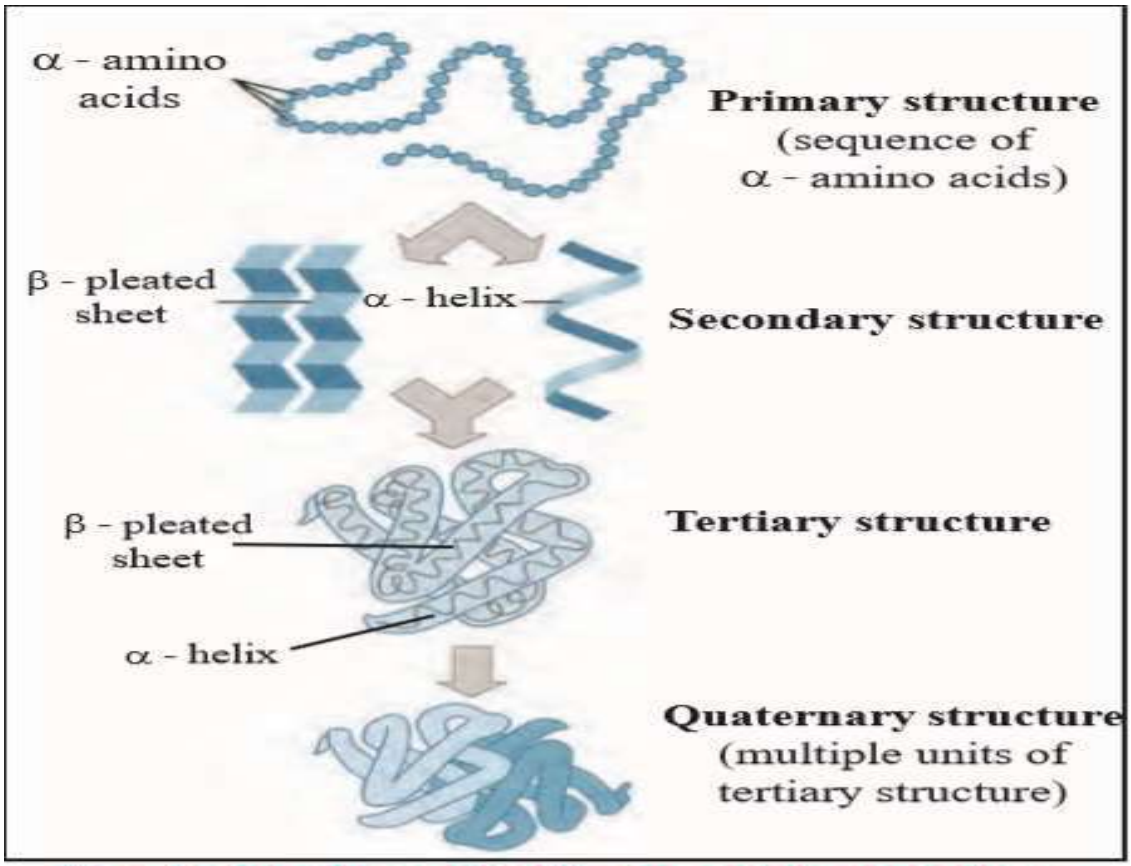


Fig. 14.22 : Four levels of protein structure

DENATURATION OF PROTEINS

DEFINITION:

Denaturation is the process by which the molecular shape of protein changes without breaking the amide/peptide bonds that form the primary structure.

OR

A process that changes the three dimensional structure of native protein is called denaturation of protein.

- Denaturation can be caused by change in pH, heating, cooling, addition of electrolyte, addition solvent like water, alcohol etc.
- Denaturation uncoils the protein, destroy the shape and thus loses their characteristic biological activity.
- For example:

1. Coagulation of Egg
2. Coagulation of Mil

CHEMICAL DISTINGUISH TEST FOR PROTEINS
[For MHT – CET / NEET / JEE]

1. BIURET REAGENT:

TEST:

Protein + 10 % NaOH + Drop of $CuSO_4$ → Reddish Violet

[Presence of –CONH – linkage]

2. MILLON'S REAGENT:

TEST:

Protein + $HgNO_3$ + $Hg(NO_3)_2$ + HNO_3 →

White ppt → (After heating) – Brick red

[Presence of –OH group (phenolic) - Tyrosine]

3. XANTHOPROTIC TEST:

TEST:

Protein + Con. HNO_3 → Yellow → (After heating)

Orange on addition of NH_4OH

[Presence of Benzene ring – Tryptophan , Skin protein]

4.NINHYDRIN SOLUTION:

TEST:

Protein + Dil Ninhydrin → Violet color

[Presence of –CONH – linkage]

PART – III – EXERCISE – IMPORTANT QUESTION (QUESTION – 2/3 Mark)

1. Define Proteins. Write examples of Proteins.
2. Explain the term α – amino acids.
3. How are α – amino acids classified on the basis of side chain?
4. What are essential amino acids? Write two examples.
5. Explain Zwitter ion.
6. What is peptide bond? How is it formed?
7. Write a short note on polypeptide.
8. Explain the following terms:
   a. Globular proteins
   b. Fibrous proteins
9. Write a note on primary structure of proteins.
10. Write a note on $2^0/3^0$ structure of proteins.
11. Explain denaturation of protein.

PART: IV – ENZYMES:

INTRODUCTION:

- It is a naturally occurring biomolecules.
- The term Enzyme is derived from Greek word "in leaven" or "in yeast", to describe this process.

DEFINITION OF ENZYMES;

Enzymes are naturally occurring bio-catalyst produced by living cells which catalyze many biological reaction in plants and animals.

OR

The proteins which perform the role of biological catalysts in the body are called enzymes.

EXPLANATION:

Every living cell contains at least 1000 different enzymes.
Most enzymes catalyze only one reaction or one group of similar reactions. Thus, enzyme catalysis is highly specific.

EXAMPLES:

1. **Insulin**, an enzyme secreted by pancreas, controls blood sugar level.
2. **Amylase**, an enzyme present in saliva, hydrolyzes starch into Glucose.

$$\text{Starch} \xrightarrow[\textit{Amylase}]{\text{Hydrolysis}} \text{n Glucose}$$

3. **Maltase**, an enzyme which hydrolyzes maltose into Glucose.

$$\text{Maltose} \xrightarrow[\textit{Maltase}]{\text{Hydrolysis}} \text{2 molecule of Glucose}$$

4. **Lactase**, an enzyme which hydrolyzes lactose into Galactose & Glucose.

$$\text{Lactose} \xrightarrow[\textit{Lactase}]{\text{Hydrolysis}} \text{Galactose \& Glucose}$$

5. **Zymase**, an enzyme that catalyzes the fermentation of sugar into ethanol and carbon dioxide.

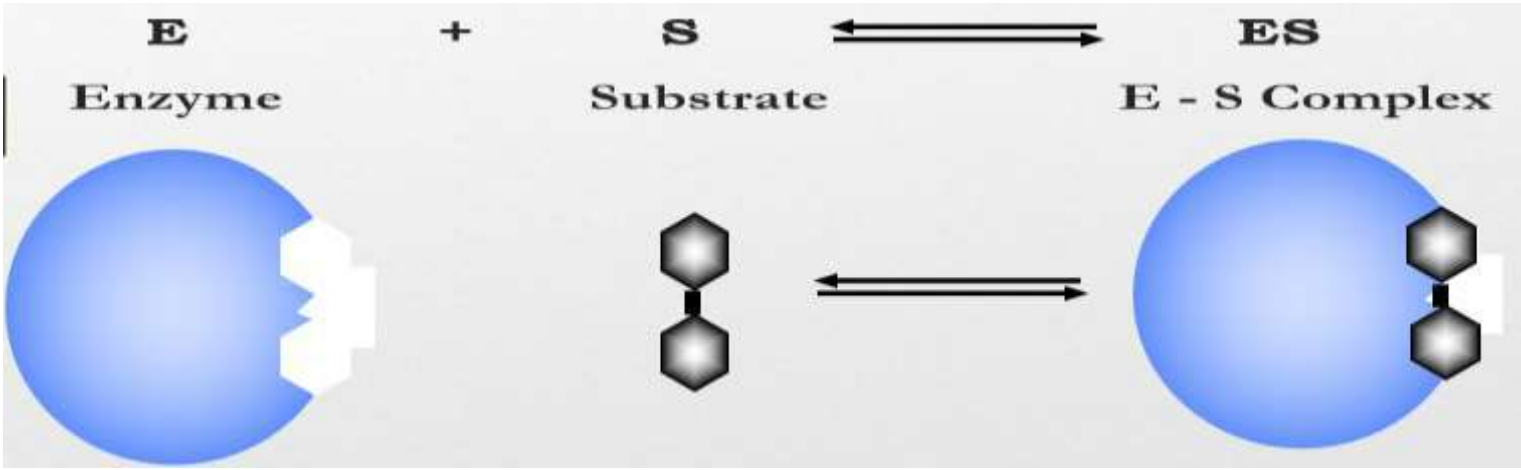
$$\text{Glucose} \xrightarrow{\textit{Zymase}} \text{Ethanol \& Carbon dioxide.}$$

MECHANISM OF ENZYME: (How Enzyme work as Bio – catalyst?)

- Action of an enzyme on a substrate is described as lock-and-key mechanism. Mechanism is divided in to 3 Steps.

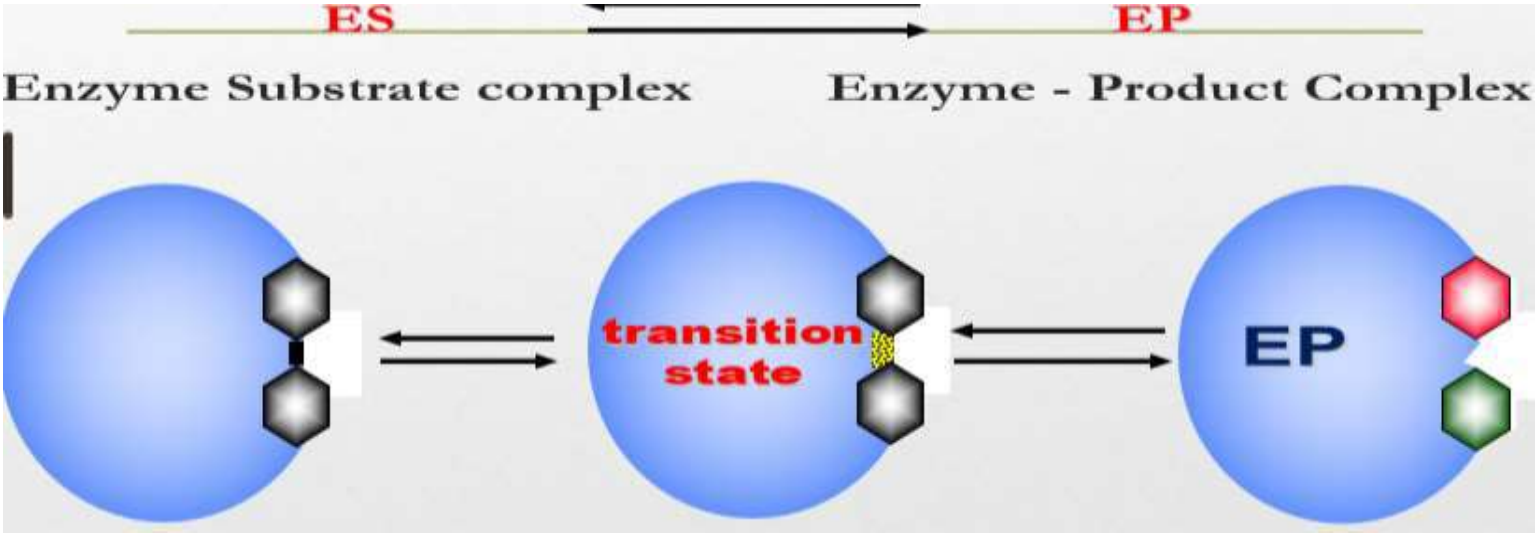
STEP – I – FORMATION OF ENZYME – SUBSTRATE COMPLEX

A substrate molecule can attach to this active site only if it has the right size and shape. Once in the active site, the substrate is held in the correct orientation to form enzyme – substrate complex.



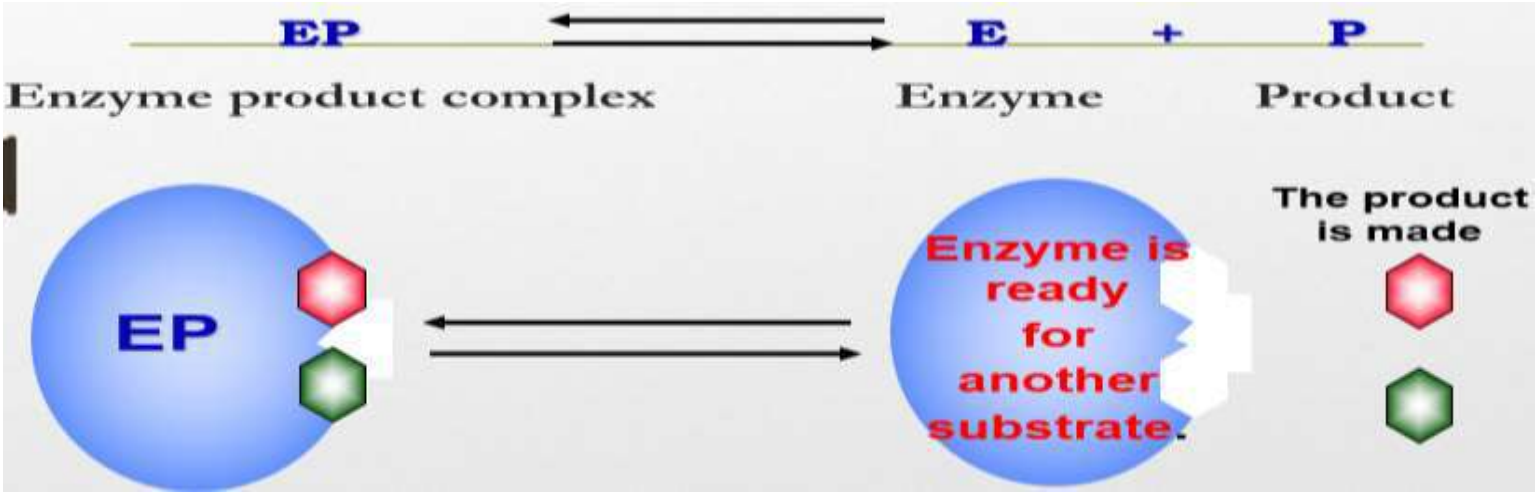
STEP – II – FORMATION OF ENZYME – PRODUCT COMPLEX

An enzyme – substrate complex slowly gets converted to Enzyme product complex because of breaking of old bond & making of new bonds.

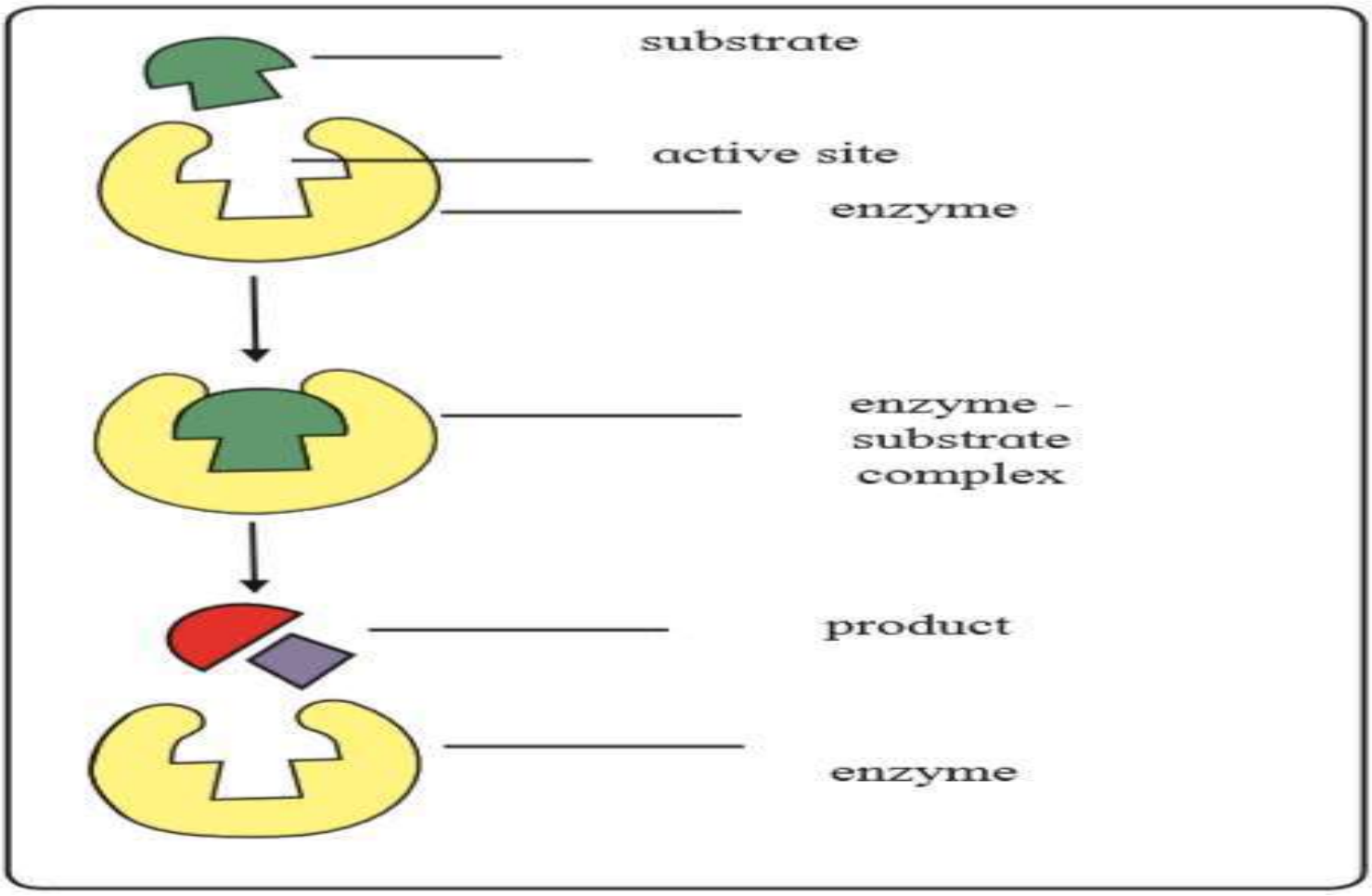


STEP – III – SEPARATION OF ENZYME & PRODUCTS:

Once the enzyme – product complex formed, products leave the active site and the enzyme is then ready to act as catalyst again.



BELOW REPRESENTATION IS FROM GOVERNMENT TEXTBOOK



INDUSTRIAL APPLICATION OF ENZYME

- Conversion of glucose to sweet-tasting fructose, using glucose isomerase.
- Manufacture of new antibiotics, using penicillin G acylase.
- Manufacture of laundry detergents, using proteases.
- Manufacture of esters used in cosmetics, using genetically engineered enzyme.
- Manufacture of cheese from Milk.

PART – IV – EXERCISE – IMPORTANT QUESTION (QUESTION – 2/3 Mark)

1. Define Enzyme. Write examples of Enzyme.
2. Explain the mechanism of Enzyme.
3. Write the application of Enzyme.

PART: V – NUCLEIC ACID:

INTRODUCTION

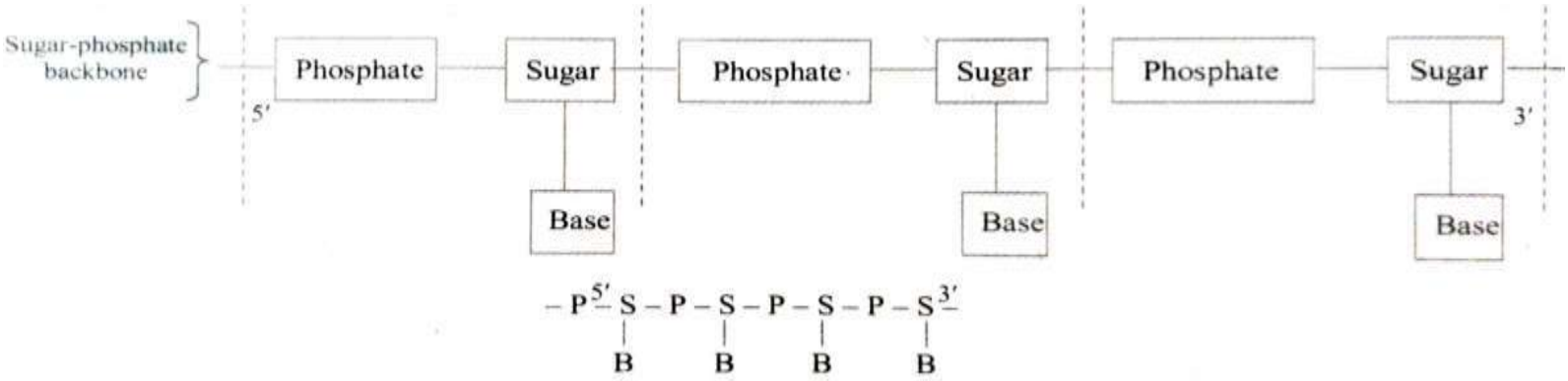
- It is a naturally occurring Biomolecules.
- Nucleic acids are the principles genetic materials of all living organisms.
- The term nucleic acid is the overall name for **DNA and RNA**, members of a family of biopolymers.
- The Nucleic acid containing C, H, O, N & Phosphorus.

DEFINITION OF NUCLEIC ACID:

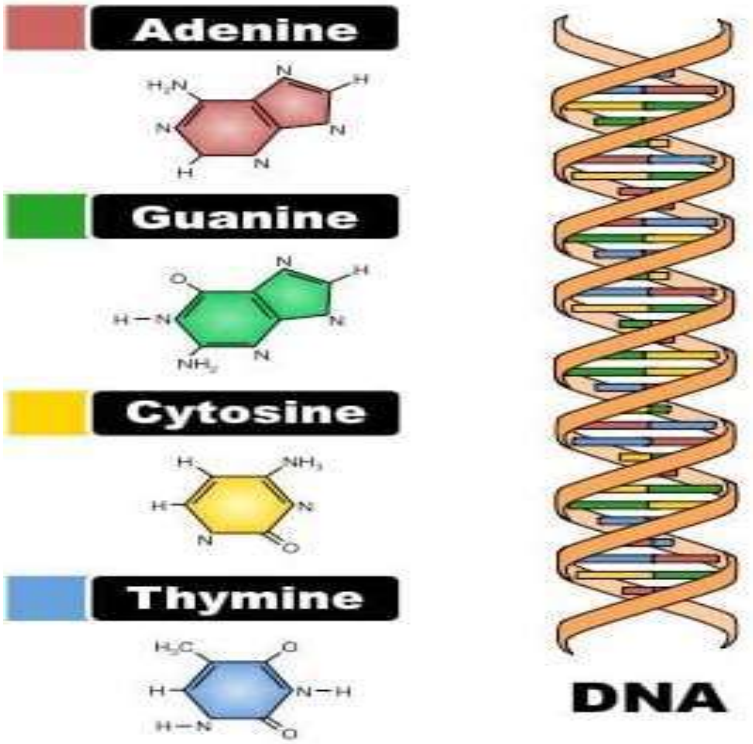
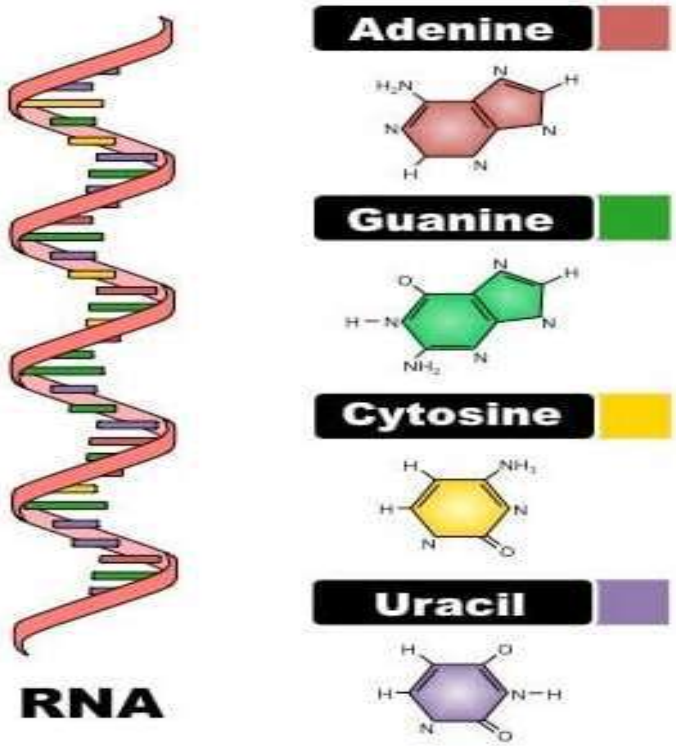
Nucleic Acid are naturally occurring biopolymer found in nuclei of the living cells in the form Nucleoproteins or Nucleosomes.

Nucleic acids are unbranched polymers of repeating monomers called nucleotides.

REPRESENTATION OF NUCLEIC ACID:

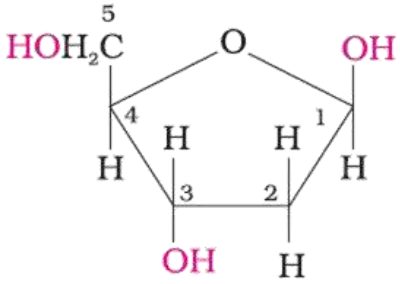
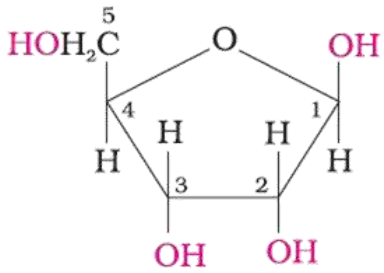


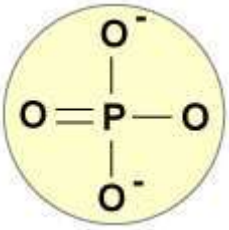
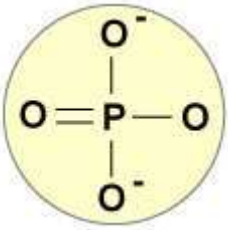
TWO TYPES OF NUCLEIC ACID

DEOXYRIBOSE NUCLEIC ACID (DNA)	RIBOSE NUCLEIC ACID (RNA)
1. It has Double stranded Helix structure. 	**1.** It has Single stranded Helix structure. 
2. It occurs in nucleus of the cell.	**2.** It occurs in cytoplasm of the cell.
3. It has unique property of replication.	**3.** It does not have property of replication.
4. It contains 2 – Deoxyribose sugar.	**4.** It contains Ribose sugar.
5. It contains bases like Adenine, Guanine, Thymine, and Cytosine.	**5.** It contains bases like Adenine, Guanine, Uracil and Cytosine.
6. It is stable & not hydrolyzed by easily by alkalis.	**6.** It is unstable & hydrolyzed by easily by alkalis.

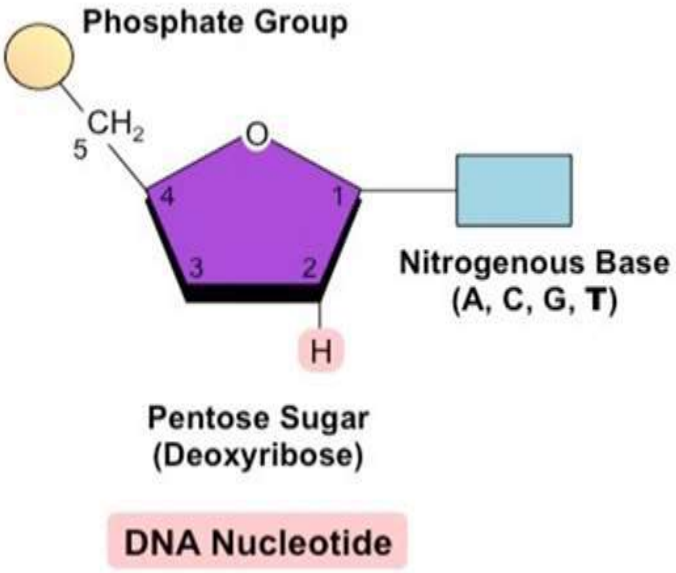
NUCLEOTIDES:

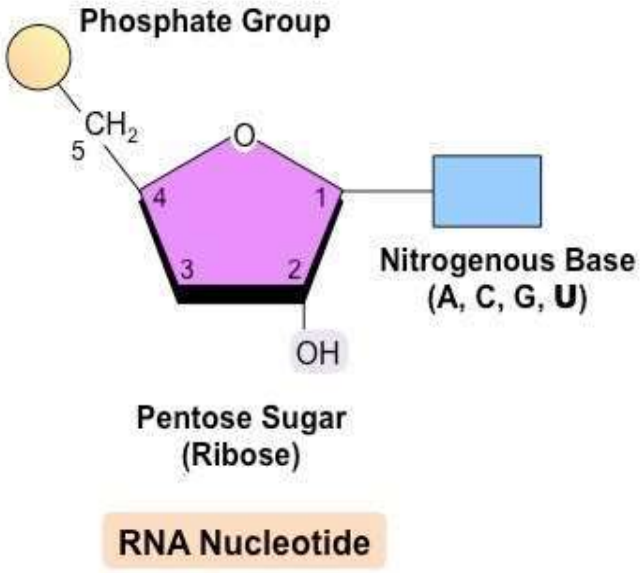
- Nucleic acids are unbranched polymers of repeating monomers called **nucleotides**.
- **DNA** contain several **million nucleotide monomers** while RNA contain few **thousand nucleotide monomers**.
- The nucleotide monomers consist of three components:
  1) a Monosaccharide(Sugar) ,
  2) a Nitrogen-containing base
  3) a Phosphate group.

DNA	**RNA**
DNA on hydrolysis produces Nucleotide as a Monomers (Millions).	RNA on hydrolysis produces Nucleotide as a Monomers (thousands).
Nucleotides of DNA contains three component. **1)Monosaccharide's (Sugar):** β – D – 2 – Deoxyribose sugar (PENTOSE SUGAR)  **2) Nitrogen-containing base:** Nitrogenous bases are of two types PURINES: Adenine (A), Guanine(G) PYRIMIDINES: Thymine (T), Cytosine (C) A = T & G ≡ C	Nucleotides of DNA contains three component. **1) Monosaccharide's (Sugar):** β – D – Ribose sugar (PENTOSE SUGAR)  **2) Nitrogen-containing base:** Nitrogenous bases are of two types PURINES: Adenine (A), Guanine(G) PYRIMIDINES: Uracil (U), Cytosine (C) A = U & G ≡ C

3) Phosphate group 	**3)** Phosphate group 

STRUCTURE REPRESENTATION OF NUCLEOTIDE:





NOTE:

Nucleotides are organic molecules consisting of a nucleoside and a phosphate.

PART – V – EXERCISE – IMPORTANT QUESTION (QUESTION – 2/3 Mark)

1. Define Nucleic acids. Write the representation of nucleic acid.
2. Distinguish between DNA & RNA.
3. Write a short note on Nucleotides.
4. Write the structure of Nucleotide in DNA & RNA.

PREVIOUS YEAR BOARD QUESTION: (MARCH 2013 to MARCH 2020)

(1) Write the structures of nucleotide and nucleoside.

(2) What happens when glucose is treated with

(a) Bromine water

(b) Dilute nitric acid

(c) Hydrogen cyanide (HCN)

(3) Describe laboratory method for preparation of glucose. Write the reaction that indicates the presence of –CHO group in glucose.

(4) Draw the simple Fisher projection formulae of D-(+)-glucose and D–(–)– fructose.

(5) How are proteins classified on the basis of molecular shapes?

(6) Define carbohydrates. What are reducing and non-reducing sugars?

(7) What are monosaccharides? Draw ring structure of

α - D - (+) - glucopyranose ?

(8) What is peptide linkage? How is tripeptide formed? (Oct. 2015)

(9) What are carohydrates?

(10) Write the structures of nucleotide.

(11) What is the action of following reagents on glucose?

(a) Bromine water

(b) Dilute HNO_3

(c) Hydroxyl amine

(12) What are 'nucleic acids'?

(13) Define enzymes.

(14) How is peptide linkage formed?

(15) What happens when glucose is treated with

(a) Hydroxylamine

(b) Hydrogen cyanide

(16) How glucose is prepared from cane sugar?

(17) What are amino acids? Write the correct reaction for formation of peptide bond between amino acids.

BIOMOLECULES - CAROHYDRTAES

MULTIPLE CHOICE QUESTIONS

STANDARD LEVEL

Introduction

1. The function of fat in the body is to act as
(a) Thermal insulator
(b) The absorber of minerals
(c) catalyst
(d) enzyme

2. The complex lifeless organic substances which build up living organisms and are required for their growth and maintenance are
(a) Grignard reagent **(b)** Fibres
(c) Biomolecules **(d)** Polymer

3. Which of the following supply maximum energy in our metabolism ?
(a) Proteins **(b)** Fats
(c) Oils **(d)** Carbohydrates

Carbohydrates

4. To become a carbohydrate, compound must contain at least
(a) 2 carbon **(b)** 4 carbon
(c) 3 carbon **(d)** 6 carbon

5. Carbohydrates are represented by the general formula
(a) $C_xH_{2x}O_{2x+2}$ **(b)** $C_x(H_2O)_x$
(c) $C_x(H_2O)_y$ **(d)** $C_x(H_2O)_{2x}$

6. Which of the disaccharide contains glucose as sub-unit ?
(a) Sucrose **(b)** Maltose
(c) Lactose **(d)** All of these

7. Glucose has _____ optical isomers.
(a) 4 **(b)** 8
(c) 16 **(d)** 10

8. Which of the following compound is a polysaccharide ?
(a) cellulose **(b)** glucose
(c) maltose **(d)** galactose

9. Cellulose is a
(a) protein **(b)** carbohydrate
(c) Simple sugar **(d)** oligosaccharide

10. Cane sugar is
(a) Glucose **(b)** Maltose
(c) Sucrose **(d)** Fructose

11. The Carbohydrate contain
(a) $-\overset{|}{C}=O$ group **(b)** $-\overset{H}{\overset{|}{C}}=O$ group
(c) – OH group **(d)** all of these

12. Stachyose is a
(a) monosaccharide **(b)** disaccharide
(c) trisaccharide **(d)** tetrasaccharide

13. Which of the following carbohydrates is a disaccharide ?
(a) Raffinose **(b)** Fructose
(c) Maltose **(d)** Glucose

14. Which of the following is aldopentose ?
(a) arabinose **(b)** glucose
(c) fructose **(d)** tristerin

15. Raffinose is an example of
(a) trisaccharide **(b)** disaccharide
(c) monosaccharide **(d)** polysaccharide

16. An animal polysaccharide is
(a) amylopectin **(b)** glycogen
(c) cellulose **(d)** amylose

17. Carbohydrate used in silvering of mirror is
(a) Fructose **(b)** Sucrose
(c) Glucose **(d)** Starch

18. Glucose can not be classified as
(a) monosaccharide **(b)** aldose
(c) carbohydrate **(d)** oligosaccharide

19. _____ carbohydrate cannot be hydrolysed in to simpler units.
(a) Disaccharide **(b)** Monosaccharide
(c) Trisaccharide **(d)** Polysaccharide

20. Hydrolysis of sucrose is called
(a) inversion **(b)** esterification
(c) saponification **(d)** hydration

21. The commonest formula of trisaccharide is
(a) $C_{18}H_{30}O_{15}$ **(b)** $C_{18}H_{32}O_{16}$
(c) $C_{18}H_{34}O_{17}$ **(d)** $C_{18}H_{36}O_{18}$

22. The monosaccharides are
(a) sweet in taste **(b)** sour in taste
(c) soluble in water **(d)** both (a) and (c)

23. Identify odd compound.

(a) Glucose **(b)** Galactose

(c) Mannose **(d)** Fructose

24. Glucose and Fructose are

(a) optical isomers **(b)** geometrical isomers

(c) functional isomers **(d)** chain isomers

25. Glucose does not contain

(a) one – CHO group **(b)** one ketonic group

(c) one – CH_2OH group **(d)** four – $\overset{|}{C}HOH$ groups

26. The number of chiral carbon atoms in a glucose molecule is

(a) 2 **(b)** 3

(c) 4 **(d)** 5

27. On hydrolysis of potato sugar final product is

(a) Fructose

(b) Glucose

(c) Canesugar

(d) Mixture of glucose and Fructose

28. Stachyose (tetrasaccharide) on hydrolysis produces

(a) one molecule of glucose and fructose and two molecules of galactose

(b) one molecule of glucose and two molecules of fructose

(c) one molecule of galactose and two molecules of glucose

(d) two molecules of glucose and fructose each

29. To prepare glucose from Canesugar _____ is added for seeding.

(a) Lactose **(b)** Sucrose

(c) Fructose **(d)** Glucose

30. Solvent used for recrystallisation of glucose is

(a) Methanol **(b)** Benzene

(c) Ethanol **(d)** Dry ether

31. For preparation of glucose from sucrose the condition required are

(a) 90% ethanol, concentrated HCl, 333 K temperature and two hours

(b) 50% ethanol, 500 K temperature and two hours

(c) 90% methanol, concentrated HNO_3, 222 K temperature and two hours

(d) water, concentrated HCl, 473 K temperature and fourtyeight hours

32. To obtain glucose, after hydrolysis of starch the resulting solution is neutralised by

(a) NaOH **(b)** KOH

(c) $NaHCO_3$ **(d)** $CaCO_3$

33. Reduction of glucose by Na/Hg and water gives

(a) Gluconic acid **(b)** Saccharic acid

(c) Sorbitol **(d)** Formaldehyde

34. Glucose when treated with conc. HNO_3 gives

(a) Acetic acid **(b)** Saccharic acid

(c) Gluconic acid **(d)** Sorbitol

35. Glucose when treated with bromine water gives

(a) Saccharic acid **(b)** Oxalic acid

(c) Glucose oxime **(d)** Gluconic acid

36. On condensation with hydroxylamine glucose gives

(a) Glucose oxime **(b)** Glucose hydrazine

(c) Glucose hydrazone **(d)** Gluco oxime

37. Excess of phenyl hydrazine when treated with glucose gives

(a) Glucose phenyl hydrazine

(b) Glucose oxime

(c) Glucose phenyl hydrazone

(d) Glucosazone

38. Acetylation of glucose give

(a) Glucose acetate **(b)** Glucose triacetate

(c) Glucose pentaacetate **(d)** Glucose diacetate

39. On heating glucose with Fehling solution, the colour of precipitate obtained is

(a) Blue **(b)** Red

(c) White **(d)** Black

40. The number of hydroxy groups in glucose is

(a) Six **(b)** Four

(c) Five **(d)** Three

41. Glucose gives silver mirror with Tollen's reagent, it shows the presence of

(a) Acidic group **(b)** alcoholic group

(c) ketonic group **(d)** Aldehydic group

42. Carbohydrate which does not undergo hydrolysis is called

(a) disaccharide **(b)** monosaccharide

(c) trisaccharide **(d)** oligosaccharide

43. Which of the following is not a monosaccharide?

(a) Glucose **(b)** Fructose

(c) Lactose **(d)** Ribose

44. Which of the following does not refer to the principle forms of carbohydrate present in our food ?

(a) Cellulose **(b)** Starch

(c) Sucrose **(d)** Fructose

45. Cane sugar on hydrolysis gives

(a) glucose and lactose **(b)** glucose and fructose

(c) glucose **(d)** glucose and maltose

46. Cellulose, glycogen and starch have a thing in common and that is

(a) glucose **(b)** fructose

(c) arabinose **(d)** erythrose

47. After hydrolysis of cane-sugar, the fructose and glucose are separated out because

(a) glucose is less soluble in alcohol

(b) fructose is more soluble in alcohol

(c) both are insoluble in alcohol

(d) both (a) and (b)

48. The polymer formed with same monosaccharide is called as

(a) heteropolysaccharide **(b)** homopolysaccharide

(c) oligosaccharide **(d)** disaccharide

49. Carbohydrates on hydrolysis produces final product which is

(a) α-amino acid **(b)** glucose

(c) oils and fats **(d)** monosaccharide

50. Which of the following is starch?

(a) $C_6H_{12}O_6$ **(b)** $(C_6H_{10}O_5)_n$

(c) $(C_6H_{12}O_6)_6$ **(d)** $C_{12}H_{22}O_{11}$

51. Which of the following is non sugar?

(a) Glucose **(b)** Sucrose

(c) Fructose **(d)** Starch

52. Which of the following is reducing sugar ?

(a) Fructose **(b)** Glucose

(c) Sucrose **(d)** Cane sugar

53. Glucose when heated with Tollen's reagent gives

(a) brown precipitate **(b)** white precipitate

(c) precipitate of pure Ag **(d)** No reaction

54. Glucose is also known as

(a) Grape sugar **(b)** Blood sugar

(c) Dextrose **(d)** All of these

55. Inulin is an example of

(a) derived protein **(b)** oligosaccharide

(c) polysaccharide **(d)** monosaccharide

56. Which of the following is dextrose?

(a) Fructose **(b)** Glucose

(c) Sucrose **(d)** Starch

57. Carbohydrate containing five hydroxyl groups and one ketone group is

(a) glucose **(b)** fructose

(c) sucrose **(d)** starch

58. Hydrolysis of disaccharide lactose gives

(a) glucose + fructose **(b)** glucose only

(c) glucose + galactose **(d)** glucose + mannose

59. Glucose converts into alcohol by the action of enzyme

(a) zymase **(b)** invertase

(c) maltase **(d)** diastase

60. Potato pulp when heated with dil. H_2SO_4 under pressure, gives

(a) sucrose **(b)** glucose

(c) glucose and fructose **(d)** glucose sucrose

61. The Carbohydrate which is the most abundant in nature is

(a) cellulose **(b)** starch

(c) glucose **(d)** fructose

62. Lactose is isomeric with

(a) glucose **(b)** maltose

(c) fructose **(d)** galactose

63. The open chain glucose and fructose have _____ and _____ chiral centre.

(a) 4, 4 **(b)** 4, 3

(c) 3, 3 **(d)** 3, 4

64. Glucose obtained from natural sources is

(a) dextro rotatory **(b)** laevo rotatory

(c) racemic mixture **(d)** meso - form

65. Carbohydrates may be regarded as

(a) aromatic compounds

(b) alicyclic compounds

(c) polyfunctional compounds

(d) aliphatic compounds

66. Why is chalk powder added after complete hydrolysis of starch?

(a) to solidify glucose **(b)** to remove $CaSO_4$

(c) to neutralize H_2SO_4 **(d)** to crystalise starch

67. Which of the following is laevo rotatory?

(a) Fructose **(b)** Glucose

(c) Sucrose **(d)** Maltose

68. Monosaccharides usually contains ... carbon atoms.

(a) C_3 to C_8 **(b)** C_1 to C_6

(c) C_4 to C_{10} **(d)** C_5 to C_8

69. Stachyose has formula

(a) $C_{12}H_{22}O_{11}$ **(b)** $C_{24}H_{42}O_{21}$

(c) $C_{18}H_{32}O_{16}$ **(d)** $C_{24}H_{42}O_{24}$

70. The common source of carbohydrates, fats and proteins is

(a) rice **(b)** milk

(c) egg **(d)** ghee

71. Maltose is

(a) reducing sugar **(b)** non sugar

(c) tetrasaccharide **(d)** non-reducing sugar

72. Which of the following statement is not correct for Fructose ?

(a) Fructose is ketohexose

(b) The cyclic five membered structure of fructose are called furanose

(c) Fructose belongs to L - series

(d) Fructose is laevorotatory compound

73. On crystallization from hot and saturated aqueous solution, β-glucose is obtained at

(a) 303 K **(b)** 323 K

(c) 371 K **(d)** 423 K

74. What is the proportion of hydrogen and oxygen in molecule of all member of carbohydrate ?

(a) 2 : 1 **(b)** 1 : 1

(c) 1 : 2 **(d)** No certain ratio

75. General formula for ____ carbohydrate is $C_nH_{2n-6}O_{n-3}$.

(a) Disaccharide **(b)** Trisaccharide

(c) Tetrasaccharide **(d)** Polysaccharide

76. Cyclic configuration for glucose is called Glucopyranose, because its cyclic chain contains _____ carbon and _____ oxygens.

(a) 6, 1 **(b)** 6, 2

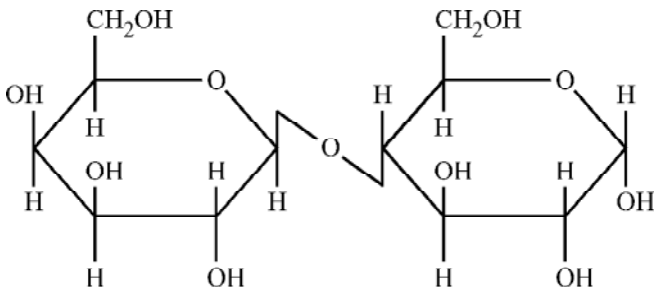
(c) 5, 1 **(d)** 4, 1

77. In sucrose α – D – (+) – glucose and β – D – (–) – Glucose are linked by _____ chain.

(a) Glycolipid **(b)** Glycosidic

(c) Phospholipid **(d)** Phosphosidic

78. Structure R is formed by joining structure P and Q, so give the names of P, Q, R.



Structure P Structure Q

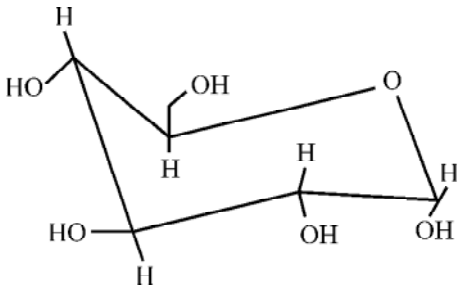
(a) P = α – D + glucose, Q = β – D + galectose, R = α + lactose

(b) P = β – D + galectose, Q = α – D + glucose, R = α + lactose

(c) P = α – D + glucose, Q = α – D + galectose, R = α + lactose

(d) P = β – D + galectose, Q = β – D + glucose, R = β – D + glucose

79. Given structure of carbohydrate is



(a) Ketohexos **(b)** Aldohexos

(c) β-furanose **(d)** β-pyranose

80. In Maltose _____ linkage is observed.

(a) Peptide **(b)** Glycoside

(c) Glyconic **(d)** Phosphate ester

81. Sucrose molecular consists of

(a) a glucofuranose and a fructopyranose

(b) a glucofuranose and a fructofuranose

(c) a glucopyranose and a fructopyranose

(d) a glucopyranose and a fructofuranose

82. The number of sp^2 and sp^3 hybridized carbon atoms in fructose are respectively.

(a) 4 and 2 **(b)** 2 and 4

(c) 1 and 5 **(d)** 5 and 1

83. Which of the following statement is not correct for Glucose?

(a) Glucose with hydrogen cyanide give glucose cyanohydrin

(b) Crystalline forms of α and β Glucose called anomers

(c) Glucose on prolonged heating with HI gives n-hexane

(d) Glucose give positive test with Schiff base

Proteins

84. Denatured protein is

(a) simple protein **(b)** derived protein

(c) fibrous protein **(d)** conjugated protein

85. The prosthetic group in Glycoproteins is

(a) Carbohydrate **(b)** Nucleic acid

(c) Glue **(d)** Fat

86. Which of the following is not protein ?

(a) DNA **(b)** nail

(c) wool **(d)** hair

87. The protein responsible for transport of oxygen in blood stream is

(a) insulin **(b)** collagen

(c) haemoglobin **(d)** albumin

Biomolecules

88. The α-amino acids are the building material of

(a) Carbohydrates **(b)** Fats

(c) Amides **(d)** Proteins

89. The protein present in hair and nails is

(a) mucin **(b)** keratin

(c) casein **(d)** albumin

90. Insulin, a hormone is chemically

(a) a fat **(b)** a steroid

(c) a carbohydrate **(d)** a protein

91. Proteins are hydrolysed by enzymes into

(a) Amines **(b)** Carboxylic acid

(c) α - amino acid **(d)** Amides

92. Among the following the fibrous protein is

(a) Casein of milk **(b)** Keratin

(c) Egg albumin **(d)** Haemoglobin

93. Peptide bond is a key feature in

(a) proteins **(b)** vitamins

(c) Nucleotide **(d)** Polysaccharide

94. Which of the following is zwitter ion ?

(a) $^{+}H_2N - \underset{\underset{R}{|}}{CH} - COO^{-}$ **(b)** $NH_3 - \underset{\underset{R}{|}}{CH} - COO^{+}$

(c) $^{+}H_3N - \underset{\underset{R}{|}}{CH} - COO^{-}$ **(d)** $^{+}H_4N - \underset{\underset{R}{|}}{CH} - COO^{-}$

95. Irreversible precipitation of proteins is called

(a) Hydrolysis **(b)** Denaturation

(c) Rearrangement **(d)** Electrolysis

96. Which of the following food stuff contain nitrogen ?

(a) Carbohydrates **(b)** Fats

(c) Proteins **(d)** both (a) and (b)

97. The prosthetic group in haemoglobin is

(a) Fe **(b)** Heme

(c) Mg **(d)** Globulin

98. The metal ion present in haemoglobin and responsible for oxygen uptake is

(a) Mg^{2+} **(b)** Fe^{3+}

(c) Co^{3+} **(d)** Ca^{2+}

99. The sequence in which amino acids are linked to one another in protein is its

(a) secondary structure **(b)** tertiary structure

(c) primary structure **(d)** quaternary structure

100. Amino acids are final products of hydrolysis of

(a) proteins **(b)** carbohydrates

(c) glycerides **(d)** alkyl halides

101. Solution of protein in alkali reacts with copper sulphate to give _____ colour product.

(a) Blue **(b)** Pink

(c) Red **(d)** Purple

102. Which of the following reagents are used in Million's test ?

(a) $HCl + CuSO_4$

(b) $HNO_3 + CuSO_4$

(c) $NaOH + CuSO_4$

(d) $Hg_2(NO_3)_2 + Hg(NO_3)_2 + HNO_3$

103. Biuret test of proteins is due to

(a) $-NH_2$ group **(b)** $-\underset{\underset{|}{}}{C} = O$ group

(c) peptide bond **(d)** O – COOH group

104. An amino acid with a hydroxyl group is

(a) alanine **(b)** tyrosine

(c) valine **(d)** phenyl glycine

105. Which of the following is a derived protein ?

(a) haemoglobin **(b)** proteoses

(c) globulin **(d)** prolamin

106. Peptide linkage in protein is tested by

(a) Millons test **(b)** Hydrazin test

(c) Carbylamine test **(d)** Biuret test

107. The simplest α-amino acid is

(a) glycine **(b)** albumin

(c) casein **(d)** valine

108. Protein gives salt with

(a) an acid

(b) a base

(c) both an acid and a base

(d) water

109. The globular protein is

(a) myosin **(b)** casein

(c) keratin **(d)** fibroin

110. The metal present in insulin is

(a) Zinc **(b)** Iron

(c) Copper **(d)** Magnesium

111. Which of the following is an amide linkage?

(a) - CO - NH - **(b)** $-\underset{\underset{H}{|}}{\overset{\overset{|}{}}{C}} - N = O$

(c) $- CO - NH_2$ **(d)** $- CO - O - NH_4$

112. The prosthetic group is present in

(a) Simple proteins **(b)** derived proteins

(c) conjugated proteins **(d)** all proteins

113. The other name of protein is

(a) Polysaccharides **(b)** Fats

(c) Polyesters **(d)** Polypeptides

114. Large molecules can be built by the combination of a number of smaller molecules. These smaller molecules are called

(a) isomers **(b)** monomers

(c) dimmers **(d)** polymers

115. Lipo protein contain the prosthetic group as

(a) carbohydrate **(b)** fat

(c) nucleic acid **(d)** phosphorus

116. Which of the following is conjugated protein ?

(a) Globulin **(b)** Haemoglobin

(c) Chlorophyll **(d)** Both b and c

117. Which of the following is not a conjugated protein?

(a) Haemoglobin **(b)** Chlorophyll

(c) Nucleoprotein **(d)** Albumin

118. In which of the following co-factor is present ?

(a) Simple protein **(b)** Conjugated protein

(c) Derived protein **(d)** Egg albumin

119. The main structural feature of proteins is

(a) Peptide linkage **(b)** Ester linkage

(c) Ether linkage **(d)** Hydrogen linkage

120. The protein which on hydrolysis produces only α-amino acids is

(a) Simple protein **(b)** conjugated protein

(c) nucleo protein **(d)** phosphoprotein

121. On heating with Conc. HNO_3 proteins give yellow colour. This test is called

(a) oxidizing test **(b)** xanthoproteic test

(c) Millons test **(d)** acid base test

122. Egg albumin is an example of

(a) globular protein **(b)** fibrous protein

(c) derived protein **(d)** conjugated protein

123. Which one of the following is fibrous protein in tendons?

(a) Keratin **(b)** Myosin

(c) Fibroin **(d)** Collagen

124. Proteins can undergo hydrolysis with

(a) acids **(b)** alkalies

(c) enzymes **(d)** all of these

125. Which of the following is not a protein ?

(a) wool **(b)** hair

(c) cellulose **(d)** nail

126. Which one of the following is the general structural formula of an α-amino acid ?

(a) RCH_2 **(b)** $RCH(NH_2)OH$

(c) RCH_2NH_2 **(d)** $RCH(COOH)NH_2$

127. Nucleoprotein has the prosthetic group

(a) phosphoric acid **(b)** glucose

(c) nucleic acid **(d)** lipids

128. Casein of milk is an example of

(a) Simple protein **(b)** nucleo protein

(c) phospho protein **(d)** glycol protein

129. Denaturated protein is

(a) Hydrolysed protein **(b)** Oxidised protein

(c) Coagulated protein **(d)** Reduced protein

130. Which of the following statement is incorrect ?

(a) A denatured protein is water insoluble

(b) A denatured protein is water soluble

(c) A denatured protein occurs on coagulation

(d) A denatured protein cannot be converted back to its original active form

131. Which one of the following molecules will form zwitter ion ?

(a) CH_3COOH **(b)** $CH_3CH_2NH_2$

(c) CCl_3NO_2 **(d)** NH_2CH_2COOH

132. The polypeptide chains run parallel and are held together by _____ bonds.

(a) Disulphide

(b) Covalent

(c) Co-ordination covalent bond

(d) None

133. Essential amino acid is

(a) Valine **(b)** Histidine

(c) Methionine **(d)** All

134. In dry solid form the amino acid exists as dipolar molecule in which carboxyl group is present as carboxylate ion and amino group is present as amonium ion this dipolar ion is also known as _____ ion.

(a) Twitterion **(b)** Zwitterion

(c) Carboxeminium **(d)** All

135. Which isn't true reason of denaturation of protein ?

(a) Detergent **(b)** Change in pH

(c) Increase in temperature **(d)** None

136. Which of the following is derived protein?

(a) Inulin **(b)** Peptones

(c) Histone **(d)** Haemoglobin

137. Magnesium is present as co-factor in which of the following?

(a) Haemoglobin **(b)** Chlorophyll

(c) Nucleoprotein **(d)** Glycoprotein

138. The coagulation of protein solution is called

(a) denaturation **(b)** deamination
(c) dehydration **(d)** degradation

Nucleic Acids

139. DNA means

(a) Deoxyribonucleic acid **(b)** Adenine triphosphate
(c) Ribonucleic acid **(d)** Polynucleotide

140. Which of the following bases is present in DNA ?

(a) Lysine **(b)** Thymine
(c) Thiamine **(d)** Uracil

141. The structure of DNA is

(a) Linear **(b)** Single helix
(c) Double helix **(d)** Triple helix

142. The molecule RNA is

(a) very large **(b)** greater than DNA
(c) equal to DNA **(d)** smaller than DNA

143. DNA is a polymer of units of

(a) Sugars **(b)** Ribose
(c) Amino acids **(d)** Nucleotides

144. Which of the following bases is not found in DNA ?

(a) Adenine **(b)** Thymine
(c) Lysine **(d)** Guanine

145. The sugar present in DNA is

(a) Deoxyribose **(b)** Ribulose **(c)** Glucose **(d)** Ribose

146. The base adenine occurs in

(a) DNA only **(b)** RNA only
(c) Protein **(d)** DNA and RNA both

147. The transfer of genetic information from one cell to the newly synthesised cell is done by

(a) DNA polymerase **(b)** RNA polymerase
(c) DNA **(d)** RNA

148. Which base is found only in the nucleotides of RNA ?

(a) Uracil **(b)** Guanine
(c) Cytosine **(d)** Adenine

149. In nucleic acids the sequence is

(a) base-phosphate-sugar **(b)** sugar-base-phosphate
(c) base-sugar-phosphate **(d)** phosphate-base-sugar

150. Nucleic acids contain _____ sugar.

(a) Hexose **(b)** Pentose
(c) Tetrose **(d)** Triose

151. Which of the following is component of nucleoside ?

(a) Phosphate group **(b)** Protein group
(c) Purine **(d)** Fat group

152. Purine base is

(a) G **(b)** C
(c) T **(d)** U

153. Pyrimidine base is

(a) C **(b)** T
(c) U **(d)** All

154. In RNA Adenine base is linked to the

(a) Thymine **(b)** Uracil
(c) Guanine **(d)** Cytocine

155. Which of the following base is not present in RNA ?

(a) Thymine **(b)** Adenine
(c) Uracil **(d)** Guanine

156. Which purine bases are joined in DNA ?

(a) Cytosine and Adenine **(b)** Cytosine and guanine
(c) Adenine and guanine **(d)** Adenine and thymine

157. Which substance isn't formed by complete hydrolysis of nucleic acid ?

(a) Hexose sugar
(b) Phosphoric acid
(c) Hetrocyclic bases which contains nitrogen element
(d) Pentose sugar

158. A unit formed by attachment of a base to _____ position of sugar is known as nucleoside.

(a) C_1 **(b)** C_2
(c) C_3 **(d)** C_4

159. Unit formed by attachment of which carbon of nucleoside to phosphate ion is known as nucleotide ?

(a) C_2 **(b)** C_3
(c) C_4 **(d)** C_5

160. In the structure of DNA, – OH group from which carbon atom is absent compared to RNA

(a) 2 **(b)** 3
(c) 5 **(d)** 5

161. The structural difference in thymine and uracil is, – H of the thymine is replaced by _____ in uracil.

(a) = O **(b)** $-CH_3$
(c) – NH **(d)** = N – H

162. Which of the following heterocyclic base of purine class ?

(a) Uracil **(b)** Thymine
(c) Guanine **(d)** Cytocine

TEST YOUR GRASP

1. Haemoglobin protein contains co-factor
(a) Mg **(b)** Fe
(c) Ca **(d)** Zn

2. Proteins does not give reaction with
(a) Millon's reagent **(b)** Biuret test
(c) Fehling's reagent **(d)** Protein

3. The polymer formed with same monosaccharide is called as
(a) heteropolysaccharide **(b)** homopolysaccharide
(c) oligosaccharide **(d)** protein

4. In peptide formation, $-NH_2$ group of one molecule condenses with
(a) – COOH group of same molecule
(b) – COOH group of another molecule
(c) – COCl group of another molecule
(d) NH_2 group of another molecule

5. Starch is the polymer of
(a) glucose **(b)** fructose
(c) sucrose **(d)** galactose

6. Sucrose on hydrolysis produces final product which is
(a) α – amino acid **(b)** only glucose
(c) oils and fats **(d)** glucose and fructose

7. Which of the following vitamin is responsible for causing beri beri ?
(a) Vitamin A **(b)** Vitamin B_1
(c) Vitamin C **(d)** Vitamin D

8. Nucleotides are bonded in the sequence
(a) base-phosphate-carbohydrates
(b) base-carbohydrate-phosphate
(c) carbohydrate-base-phosphate
(d) phosphate-base-carbohydrate

9. Which of the following is plant protein ?
(a) Haemoglobin **(b)** Chlorophyll
(c) Albumin **(d)** Collagen

10. Compound containing both $-NH_2$ and – COOH groups are called
(a) Acid **(b)** Base
(c) α – amino acid **(d)** Amino acid

11. There are _____ types of RNA.
(a) Two **(b)** Three
(c) Four **(d)** Five

12. Inulin is an example of
(a) derived protein **(b)** conjugated protein
(c) polysaccharide **(d)** simple protein

13. Oligosaccharides contain how many monosaccharide units ?
(a) 2 – 10 **(b)** 11 – 15
(c) one **(d)** 2 – 15

14. Which of the following is not a conjugated protein ?
(a) Haemoglobin **(b)** Chlorophyll
(c) Nucleoprotein **(d)** Albumin

15. Carbohydrates are stored in the body as
(a) Sugar **(b)** Starch
(c) Glycogen **(d)** Fat

16. Deficiency of vitamin A results in
(a) Retarded growth **(b)** Loss of appetite
(c) Sterility **(d)** Skin diseases

17. Which of the following is dextrose ?
(a) Fructose **(b)** Glucose
(c) Sucrose **(d)** Starch

18. Enzymes belong to which class of compounds ?
(a) Polysaccharides **(b)** Hydrocarbons
(c) Polynitrogen **(d)** Polypeptides

19. The sweetest of all sugars is
(a) Glucose **(b)** Fructose
(c) Starch **(d)** Cane sugar

20. Which of the following is used to obtain glucose from starch ?
(a) dilute HCl under pressure
(b) alcoholic HCl
(c) dilute H_2SO_4 under pressure
(d) both (a) and (c)

21. Blood sugar has the following formula
(a) $C_{12}H_{22}O_{11}$ **(b)** $(C_6H_{10}O_5)_n$
(c) $C_6H_{12}O_6$ **(d)** $C_5H_{10}O_5$

22. Which of the following vitamins is related to sterol structure ?
(a) Vitamin E **(b)** Vitamin B
(c) Vitamin D **(d)** Vitamin A

23. Enzymes

(a) consists of amino acids

(b) have optimum activity, at body temperature

(c) are carbohydrates

(d) have all these properties

24. Glucose is a

(a) aldohexose having three asymmetric carbon atoms

(b) aldoketose having four asymmetric carbon atoms

(c) aldohexose having four asymmetric carbon atoms

(d) aldoketose having three asymmetric carbon atoms

25. Which of the following is not found in carbohydrates ?

(a) Carbon **(b)** Hydrogen

(c) Nitrogen **(d)** Oxygen

26. Raffinose is an example of

(a) disaccharide **(b)** trisaccharide

(c) monosaccharide **(d)** polysaccharide

27. The part of the body organs where hormones are produced are called

(a) Target **(b)** Origin

(c) Effectors **(d)** Duct glands

28. The polymer formed with different monosaccharide is called as

(a) heteropolysaccharide **(b)** homopolysaccharide

(c) disaccharide **(d)** trisaccharide

29. Neutral amino acid contains

(a) two – NH_2 and one – COOH group

(b) one – NH_2 and one – COOH group

(c) one – NH_2 and two – COOH groups

(d) two – NH_2 and two – COOH groups

30. Carbohydrates contains which of the following group ?

(a) – CHO **(b)** > C = O

(c) – COOH **(d)** both (a) and (b)

31. Which of the following is not sugar ?

(a) Sucrose **(b)** Starch

(c) Fructose **(d)** Glucose

32. Fructose is

(a) Aldopentose **(b)** Aldohexose

(c) Ketopentose **(d)** Ketohexose

33. Oxidation product of glucose with bromine water is

(a) Sorbitol **(b)** Gluconic acid

(c) Glutamic acid **(d)** Saccharic acid

34. Haemoglobin is the example of

(a) Simple protein **(b)** Derived protein

(c) Fibrous protein **(d)** Conjugated protein

35. The most common cerebrosides are

(a) Galactose **(b)**

(c) Galactocerebrosides **(d)** Glycerols

ANSWERS

1. b	**2.** c	**3.** b	**4.** b	**5.** a
6. d	**7.** b	**8.** b	**9.** b	**10.** d
11. b	**12.** c	**13.** a	**14.** d	**15.** c
16. c	**17.** b	**18.** d	**19.** b	**20.** c
21. c	**22.** c	**23.** b	**24.** c	**25.** c
26. b	**27.** c	**28.** a	**29.** b	**30.** d
31. b	**32.** d	**33.** b	**34.** d	**35.** c

HOME WORK MCQS FOR PRACTISE

Dextrose is a/an

a) aldohexose b) ketohexose c) aldopentose d) ketopentose

The sugar present in milk in

a) sucrose b) maltose c) glucose d) lactose

Blood sugar and fruit sugar are respectively

a) glucose, fructose b) fructose, glucose c) glucose,glucose d) sucrose, fructose

Starch is made of

a) amylose and glycogen b) amylose and amylopectin

c) glucose and glycogen d) none of these

Which of the following disaccharides is made up of two same monosaccharide units ?

a) Maltose b) Sucrose c) Lactose d) none of these

Glucose and Mannose are

a) optical isomers b) anomers c) epimers d) isotopes

Which of the following molecules has the general formula as that of carbohydrate, but is not a carbohydrate ?

a) Arabinose b) Glyceraldehyde c) Acetic acid d) Ribose

The specific rotation of a freshly prepared solution of cane sugar changes with time and finally attains a constant value. This is called

a) Inversion b) Mutarotation c) Isoelectric point d) Optical rotation

Which reagent is used to distinguish between cane sugar and glucose solution ?

a) Molish's reagent b) Conc. H_2SO_4 c) Fehling's solution d) Baeyer's reagent

Diabetes is detected by testing patient's urine with

a) Tollen's reagent b) Fenton's reagent c) Nessler's reagent d) Benedict's solution

Select the one from the following which does not belong to the class to which the other three belong.

a) Galactose b) Fructose c) Glucose d) Maltose

HOME WORK MCQS FOR PRACTISE

Animal starch is the name given to

a) glycogen b) lactogen c) cellulose d) none of these

Amylopectin is a polymer of

a) β-D-glucose b) α-D- glucose c) β-D-fructose d) α-D-fructose

Molisch's test is answered by

a) glucose b) fructose c) sucrose d) all carbohydrates

Glucose cannot be classified as

a) a hexose b) a carbohydrate c) an oilgosaccharide d) an aldose

Indigestible carbohydrate which is also constituent of our diet is

a) starch b) cellulose c) galactose d) maltose

Which of the following does not reduce Benedict's solution ?

a) Sucrose b) Aldehyde c) Glucose d) Fructose

A sugar that is not a disaccharide among the following is

a) maltose b) sucrose c) galactose d) lactose

Water insoluble component of starch is

a) amylopectin b) amylose c) cellulose d) none of these

Which gives red colour with Fehling solution ?

a) Glucose b) Fructose c) Maltose d) All the three

α-glucose and β-glucose differ in configuration at ..... and are called .....

a) C_1, anomers b) C_2, anomers c) C_2, epimers d) C_3, tautomers

Which of the following is an oligosaccharide ?

a) Fructose b) Lactose c) Galactose d) Glycogen

HOME WORK MCQS FOR PRACTISE

The number of optical isomers of glucose and fructose are respectively

a) 16, 8 b) 8, 16 c) 8, 4 d) 4, 8

Which is correct ?

a) Starch is a polymer of α-glucose b) Amylose is a component of cellulose

c) Proteins are composed of only one type of amino acids.

d) In cyclic structure of furanose, there are four carbons and one oxygen atom.

Glucose on reduction with Na/Hg and water gives

a) sorbitol b) saccharic acid c) sorbitol + mannitol d) hexane

The number of sp^2 and sp^3 hybridized carbon atoms in fructose are respectively

a) 1 and 5 b) 5 and 1 c) 2 and 4 d) 4 and 2

Glycosidic linkage is present between the two glucose units at positions ..... in maltose.

a) 1, 2 b) 1, 3 c) 1, 4 d) 1, 1

Glucose is said to have -CHO group but it does not react with

a) Br_2 water b) Fehling solution c) CH_3OH d) $NaHSO_3$

In amylopectin, branching occurs through

a) 1, 2 - -limkage b) 1, 3 - linkage c) 1, 4 - linkage d) 1, 6 - linkage

Among the naturally occuring carbohydrates, furanose ring is found in the

a) glucose unit of cane sugar b) fructose unit of cane sugar

c) glucose unit of cellulose d) galactose unit of lactose

Sucrose molecule consists of

a) a glucopyranose and a fructopyranose b) a glucopyranose and a fructofuranose

c) a glucofuranose and a fructopyranose d) a glucofuranose and a fructofuranose

Glucose and galactose differ in the position of -H and -OH group on which carbon atom ?

a) Second b) Third c) Fourth d) Fifth

Fructose gives silver mirror test and Fehling solution test because of

a) -CHO group b) $>C=O$ group c) enolisation d) acidification

An organic compound is found to contain C, H and O as elements. It is soluble in water, chars with conc. sulphuric acid and also gives purple colour with Molisch reagent. The Fehling solution test is negative but it forms a blue colour with iodine. The organic compound should be

a) glucose b) fructose c) starch d) meso-tartaric acid

HOME WORK MCQS FOR PRACTISE

The relative sweetness of Lactose, Maltose, Fructose and Invert sugar is

a) Maltose < Lactose < Invert sugar < Fructose
b) Invert sugar < Lactose < Maltose < Fructose
c) Lactose < Maltose < Fructose < Invert sugar
d) Lactose < Maltose < Invert sugar < Fructose

Column I	Column II
I) Blood sugar	i) Glucose
ii) Grape sugar	ii) Fructose
iii) Invert sugar	iii) Glucose
iv) Fruit sugar	iv) Glucose + Fructose

	I	II	III	IV
a)	(i)	(ii)	(iv)	(iii)
b)	(i)	(iv)	(iii)	(ii)
c)	(i)	(iii)	(iv)	(ii)
d)	(i)	(iii)	(ii)	(iv)

α-D-(+)-glucose and β-D-(+)- glucose are

a) enantiomers b) conformers c) epimers d) anomers

The pair of compounds in which both the compounds give positive test with Tollen's reagent is

a) glucose and sucrose
b) glucose and fructose
c) acetophenone and hexannal
d) fructose and sucrose

The two forms D-glucopyranose obtained from the solution of D-glucose are called

a) Isomers b) anomers c) epimers d) enantiomers

Which is a monosaccharide ?

a) sucrose b) Lactose c) Fructose d) Cellulose

Ribose is an example of

a) ketohexose b) disaccharide c) pentose d) polysaccharide

HOME WORK ANSWERS

Answer : a) Aldohexose
Dextrose is famously known as Glucose which is aldohexose.

Answer : d) Lactose
Milk contains lactose sugar

Answer : a) Glucose and Fructose
Glucose word is derived From Greek word for sweet wine; grape sugar, blood sugar, dextrose.
Fructose word is derived from Latin word for fruit--"fructus", also known as laevulose, found in fruits (fruit sugar)

Answer : b) Amylose and amylopectin
Starch is combination of Amylose and amylopectin

Answer : a) Maltose
Maltose is the formation of 2 molecules of monosaccharides.

Answer : c) Epimers
The example under Aldohexose like Glucose , Mannose, Galactose, Gulose , Allose etc. have same molecular formula ,same functional group but they all are differ by position of -OH group at specific carbon. Hence they all are Epimers

Answer : c) Acetic acid
Acetic acid [$C_2(H_2O)_2$] satisfy the general formula of carbohydrates but not called as carbohydrates because it doesn't contain 3 carbon and not optical active in nature.

Answer : b) Mutarotation
Mutarotation is the change in the optical rotation because of the change in the equilibrium between two anomers, when the corresponding stereo centers interconvert. Cyclic sugars show **mutarotation** as α and β anomeric forms interconvert.

Example: Glucose in cyclic structure forms two optical rotation α and β anomer .At equilibrium, the mixture consists of about 36% α-D-**glucose**, 64% β-D-**glucose**, and less than 0.02% of the open-chain aldehyde form.

Answer : c) Fehling Solution
Glucose can be easily detected by Fehling solution due to presence of aldehyde group whereas Cane sugar (Sucrose) do not have aldehyde , hemiacetal,hemiketal group.
Hence Sucrose gives negative test with Fehling solution whereas Glucose gives positive test with Fehling solution.

Answer : d) Benedict's solution
Benedict's solution test easily detect the presence of glucose in urine.

Answer : c) Glucose
Sucrose, Maltose, Lactose belong to disaccharides whereas Glucose is a monosaccharide's.

Answer : a) Glycogen

Answer : b) α-D-**glucose**
Amylose and Amylopectin both contain α-D-glucose as monomer.

Answer : d) All carbohydrates
All carbohydrates compounds gives positive Molisch's test.

Answer : c) Oligosaccharides

Answer : b) Cellulose

Answer : a) Sucrose

Sucrose (table sugar) contains two sugars (fructose and glucose) joined by their glycosidic bond in such a way as to prevent the glucose isomerizing to aldehyde, or the fructose to alpha-hydroxy-ketone form. Sucrose is thus a **non-reducing** sugar which **does not** react with **Benedict's reagent**.

Answer : c) Galactose
Sucrose, Maltose, Lactose belong to disaccharides whereas Galactose is a monosaccharide's.

Answer : a) Amylopectin
Refer Starch Notes

Answer : d) All the three
All Monosaccharide's , Oligosaccharides (except Sucrose) gives positive test with Fehling's reagent

Answer : a) C1 , Anomers
α-D-glucose having C1 attach to OH group down whereas β-D-**glucose** C1 attach to OH group up.

Answer : b) Lactose

HOME WORK ANSWERS

Answer : a) 16 , 8

Answer : a) Starch is a polymer of α-D-glucose

Answer : a) Sorbitol
Refer chemical properties of Glucose

Answer : a) 1 and 5

Answer : c) 1, 4

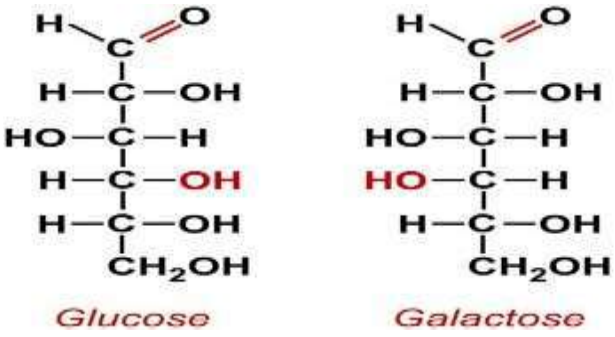
Answer: d) $NaHSO_3$
Open structure of Glucose do not react with $NaHSO_3$ whereas α-D-glucose and β-D-glucose reacts easily due to presence of Hemiacetal group.

Answer: d) 1, 6 linkages
Refer Starch notes

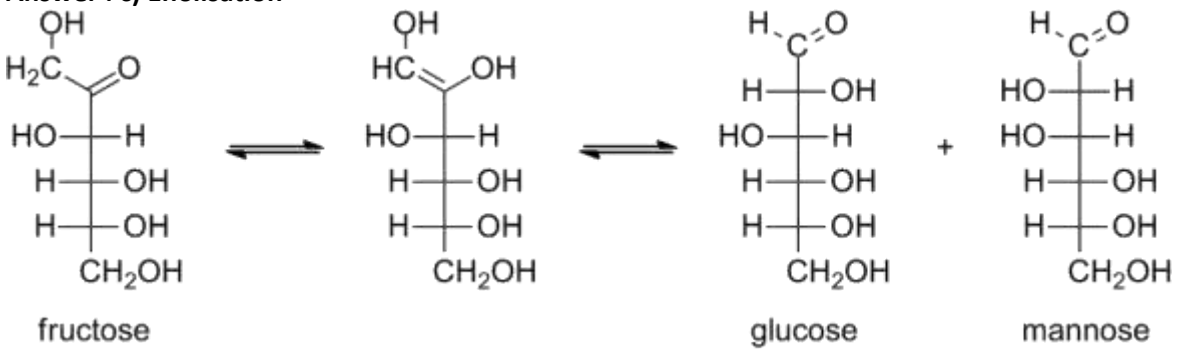
Answer : b) fructose unit of Cane sugar
Cane sugar is the formation of Glucose (Glucopyranose ring) and Fructose (Fructofuranose ring).

Answer : b) a Glucopyranose and a Fructofuranose

Answer : c) fourth



Answer : c) Enolisation



I **II**

(Keto group) Changes to (enol) which further arranges to from Glucose and mannose.

Fructose reduces Tollens and Fehling reagent even though it contains no aldehyde group.
Reduction occurs because the reagents are basic solutions and fructose is readily isomerized (keto to enol called as enolisation) to a mixture of aldoses (glucose and mannose) under basic conditions.

Answer : c) Starch
Starch is a polysaccharide type of carbohydrate which gives positive test with Iodine solution and Molisch reagent whereas Fehling reagent negative because starch do not contain Aldehyde,Hemiacetal or Hemiketal group.

Answer d) Lactose < Maltose < Invert sugar < Fructose

Relative Sweetness Scale - Sucrose = 100	
Compound	Rating
Sucrose	100
Fructose	140
High Fructose Corn Syrup	120-160
Glucose	70-80
Galactose	35
Maltose	30-50
Lactose	20

Note: Carbohydrates having kenotic group will have more sweetening power.

HOME WORK ANSWERS

Answer : d) **Blood Sugar – Glucose** **Grape sugar – Glucose** **Invert Sugar – Glucose + Fructose** **Fruit Sugar – Fructose**
Answer: d) Anomers
Answer: b) Glucose and Fructose
Answer: b) Anomers
Answer: c) Fructose
Answer: c) Pentose

14.3 Proteins

The protein present in hair and nails is
(A) mucin (B) keratin (C) casein (D) albumin

The prosthetic group in Glycoproteins is
(A) Carbohydrate (B) Nucleic acid (C) Glue (D) Fat

Which of the following reagents are used in Million's test?
(A) $HCl + CuSO_4$
(B) $HNO_3 + CuSO_4$
(C) $NaOH + CuSO_4$
(D) $Hg_2(NO_3)_2 + Hg(NO_3)_2 + HNO_3$

The α-amino acids are the building material of
(A) Carbohydrates (B) Fats (C) Amides (D) Proteins

The prosthetic group is present in
(A) Simple proteins
(B) derived proteins
(C) conjugated proteins
(D) all proteins

Lipo protein contain the prosthetic group is
(A) carbohydrate (B) fat (C) nucleic acid (D) phosphorus

Colour developed when a drop of aqueous $CuSO_4$ is added to alkaline solution of protein is
(A) Yellow (B) Blue (C) Green (D) Violet

The simplest α-amino acids is
(A) alanine (B) glycine (C) valine (D) cysteine

An amino acid with a hydroxyl group is
(A) alanine (B) tyrosine (C) valine (D) phenyl glycine

Which of the following statement is incorrect?
(A) A denatured protein is water insoluble
(B) A denatured protein is water soluble
(C) A denatured protein occurs on coagulation
(D) A denatured protein cannot be converted back to its original active form

Essential amino acid is
(A) Valine (B) Histidine (C) Methionine (D) All

Which of the following is an amphoteric acid?
(A) glycine (C) benzoic acid (B) salicylic acid (D) citric acid

Primary structure of protein contains which type of bond?
(A) only hydrogen (B) only covalent (C) only van der Waals (D) all of these

Which of the following set consists only of essential amino acids.

(A) Alanine, tyrosine, cystine
(B) Leucine, lysine, tryptophan
(C) Alanine, glutamine, lysine
(D) Leucine, proline, glycine

Fibrous proteins are present in :

(A) wool (B) muscles (C) silk (D) all of these

Proteins are condensation polymers of

(A) α-Amino-acids (B) β-Amino acids (C) α-Hydroxy acids (D) β-Hydroxy acids

The non-protein portion of a protein is called

(A) Functional group (B) Characteristic group (C) Prosthetic group (D) Enolic group

Diabetes is detected by testing urine of the patient with :

(A) Tollen's reagent (B) Nessler's reagent (C) Fenton's reagent (D) Benedict's solution

For $-\overset{\overset{O}{\|}}{C}-\ddot{N}H$ (peptide bond)

(A) C – N bond length in proteins is longer than usual bond length of the C – N bond
(B) Spectroscopic analysis shows planar structure of the –CO – NH – group
(C) C – N bond length in proteins is smaller than usual bond length of the C – N bond
(D) None of the above

The bond that determines the secondary structure of proteins is secondary structure of protein is due to

(A) Coordinate bond (B) Covalent bond (C) Hydrogen bond (D) Peptide bond

The main structural feature of proteins is

(A) The ester linkage (B) The ether linkage (C) The peptide linkage (D) All of these

The number of essential amino acids in man is

(A) 8 (B) 10 (C) 18 (D) 20

The protein present in hair and nails is

(A) mucin (B) keratin (C) casein (D) albumin

Which of the following is zwitter ion?

(A) $^{+}H_2N-\underset{\underset{R}{|}}{CH}-COO^{-}$

(B) $NH_3-\underset{\underset{R}{|}}{CH}-COO^{+}$

(C) $^{+}H_3N-\underset{\underset{R}{|}}{CH}-COO^{-}$

(D) $^{+}H_4N-\underset{\underset{R}{|}}{CH}-COO^{-}$

Carbohydrate is present as prosthetic group in which of following :
(A) Nucleoprotein (B) Glycoprotein (C) Phosphoprotein (D) Lipoprotein

Tripeptide contains ___ pep tide linkages.
(A) 3 (B) 2 (C) 6 (D) 9

The protein which on hydrolysis produces only amino acids is
(A) Simple protein (B) conjugated protein (C) nucleo protein (D) phosphoprotein

The peptide bond is
(A) $-CONH_2$ (B) $-CONH-$ (C) $-COONH_4$ (D) $-N=C=O$

Which of the following is a fibrous protein?
(A) Hemoglobin (B) Albumin (C) Keratin (D) Enzymes

Denaruration of proteins can be brought about
(A) Heat (B) Mineral acids (C) Bases (D) All the three

The non protein portion of a protein is called
(A) Functional group (B) Characteristic group (C) Prosthetic group (D) Enolic group

The function of proteins is to act as
(A) Structural materials of animal tissues (B) Enzymes and antibodies
(C) Metabolic regulators. (D) All the three above.

Peptides on hydrolysis give
(A) Amines (B) Amino acids (C) Ammonia (D) Alcohols

The number of tripeptides formed by three different amino acids are
(A) Three (B) Four (C) Five (D) Six

Keratin is a
(A) simple protein (B) derived protein (C) globular protein (D) conjugated protein

14.4 Enzymes

Which of the following enzymes hydrolyses triglycerides to fatty acids and glycerol?
(A) Amylase (B) Maltase (C) Lipase (D) Pepsine

Enzyme trypsin converts
(A) starch into sugar
(B) proteins into α-amino acids
(C) glucose into glycogen
(D) α-amino acids into proteins

The co-factor of enzyme is
(A) a protein molecule
(B) a non-protein molecule
(C) a vitamin B_6
(D) a nucleotide

A biological catalyst is essentially
(A) an amino acid
(B) an enzyme
(C) a nitrogen molecule
(D) a carbohydrate

Enzymes take part in a reaction and
(A) decrease the rate of a chemical reaction
(B) increase the rate of a chemical reaction
(C) Both (A) and (B)
(D) None of these

14.8 Nucleic acids

The molecule RNA is
(A) very large (B) greater than DNA (C) equal to DNA (D) smaller than DNA

Which base is found only in the nucleotides of RNA?
(A) Uracil (B) Guanine (C) Cytosine (D) Adenine

Nucleic acids contain ____ sugar.
(A) Hexose (B) Pentose (C) Tetrose (D) Triose

Which of the following base is not present in RNA?
(A) Thymine (B) Adenine (C) Uracil (D) Guanine

DNA is a polymer of units of
(A) Sugars (B) Ribose (C) Amino acids (D) Nucleotides

Purine base is
(A) G (B) C (C) T (D) U

Pyrimidine base is
(A) C (B) T (C) U (D) All

Unit formed by attachment of which carbon of nucleoside to phosphate ion is known as nucleotide?
(A) C_2 (B) C_3 (C) C_4 (D) C_5

The substance of heredity are
(A) Vitamins (B) Enzymes (C) Carbohydrates (D) Nucleic acids

The backbone of nucleic acid is
(A) Polyamide (B) Polynucleotide (C) Lipid (D) Hormone

Polynucleotide is
(A) Amide
(B) Anhydride
(C) Ester of phosphoric acid with sugar
(D) Ester of carboxylic acid and alcohol

The sugar present in RNA is . . . and in DNA is
(A) D-glucose, L-fructose
(B) D-ribose, D-2-deoxyribose
(C) D-2-deoxyribose, D-ribose
(D) L-Fructose, D-glucose

A base sugar unit is called
(A) Nucleoside
(B) Nucleotide
(C) Protein
(D) Carbohydrate

A base sugar phosphoric acid unit is called
(A) Nucleoside
(B) Nucleotide
(C) Protein carbohydrate
(D) Carbohydrate protein

Nucleotides are joined together through
(A) Phosphate ether linkage
(B) Phosphate ester linkage
(C) Phosphate amide linkage
(D) Phosphate acid linkage

The bases present in nucleic acids are
(A) NaOH, $NaHCO_3$
(B) Aromatic amines
(C) Purines, pyrimidines
(D) Aliphatic amines

Two polynucleotide chains wound about each other by
(A) C – O – C – bonds
(B) N – N – bonds
(C) $-NH_2$ bonds
(D) – N – H – H – N – bonds

Structure of DNA molecule is as a
(A) Linear
(B) Single helix
(C) Double helix
(D) Triple helix

Synthesis of proteins is controlled by
(A) DNA
(B) RNA
(C) Sugars
(D) Lipids

Heredity is controlled by
(A) Nucleic acids
(B) Sugars
(C) Lipids
(D) Enzymes

The base adenine occurs in
(A) DNA only
(B) RNA only
(C) DNA and RNA both
(D) Hormones

The protein which maintains blood sugar level in human body
(A) Haemoglobin
(B) Oxytoxin
(C) Insulin
(D) Ptyalin

Which is not constituent of RNA
(A) Ribose
(B) Phosphate
(C) Adenine
(D) Pyridine

Which of the following proteins acts as messenger in living systems
(A) Hormone
(B) Enzyme
(C) Protective protein
(D) Transport protein

Which substance is not present in nucleic acid
(A) Cytosine
(B) Adenine
(C) Thymine
(D) Guanidine

Which of the following is not present in nucleic acids
(A) Uracil
(B) 2-Aminopyridine
(C) Thymine
(D) Adenine

In nucleic acids the sequence is
(A) Base-phosphate-sugar
(B) Phosphate base sugar
(C) Sugar base phosphate
(D) Base-sugar-phosphate

The base present in DNA but not in RNA is
(A) Guanine (B) Adenine (C) Uracil (D) Thymine

Mutation of DNA occurs due to changes in the sequence of one of the following
(A) Bases (B) Ribose units (C) Phosphate units (D) Sugar units

Purine derivative among the following bases is
(A) Guanine (B) Cytosine (C) Thymine (D) Uracil

RNA is different from DNA because RNA contains
(A) Ribose sugar sugar and thymine
(B) Ribose sugar and uracil
(C) Deoxyribose sugar and thymine
(D) Deoxyribose sugar and uracil

The reason for double helical structure of DNA is operation of
(A) van deir waals forces
(B) Diple dipole interaction
(C) Hydrogen bonding
(D) Electrosatic attraction

The function of DNA in an organism is
(A) To assist the synthesis of RNA
(B) To store information of heredity characteristics
(C) To assist the synthesis of proteins and polypeptides
(D) All of these

Nucleic acid is polymer of
(A) Nucleosides (B) α-amino acids (C) Nucleotides (D) Glucose

A nucleoside on hydrolysis gives
(A) A heterocyclic base and orthophosphoric acid
(B) A aldopentose, heterocyclic base and phosphoric acid
(C) An aldopentose and heterocyclic base
(D) An aldopentose and orthophosphoric acid

An alternation in the base sequence of nucleic acid molecule is called
(A) Replication (B) Mutation (C) Duplication (D) Dislocation

RNA and DNA are chiral molecules. Their chirality is due to
(A) L-sugar component
(B) Chiral bases
(C) Chiral phosphate ester units
(D) D-sugar component

Pyrimidine bases present in DNA are
(A) Cystosine and adenine
(B) Cystosine and guanine
(C) Cystosine and thymine
(D) Cystosine and uracil

Human body does not produce
(A) Hormones (B) Enzymes (C) DNA (D) Vitamins

Which sugar is present in DNA?
(A) purine only (B) deoxyribose (C) ribose (D) Pyrimidine only

The human body does not produce
(A) Vitamins (B) Hormones (C) Enzymes (D) DNA