14. Biomolecules

Section–I : Carbohydrates

14.0 GENERAL INTRODUCTION

The complex organic molecules which form the basis of life i.e. which build up living organisms and also required for their growth and maintenance are known as biomolecules. Some common examples are carbohydrates, proteins, fats, enzymes, amino acids, nucleic acids, lipids, steroids, hormones, vitamins etc.

Some of them biomolecules are micromolecules and polymeric or non polymeric macromolecules.

Micromolecules : They includes small molecules containing up to 30 carbon atoms and having molecular mass 100 to 1000. These are present in free state in cell.

Macromolecules : These are large molecules having very high molecular mass. They may be polymeric or nonpolymeric.

e.g. Proteins (polymeric), Chlorophyll (non polymeric), Haemoglobin (non polymeric), Starch (polymeric)

14.1 SECTION–I CARBOHYDRATES

14.1.1 Introduction

Carbohydrates are considered as hydrates of carbon. They have general formula $C_n(H_2O)_n$. But however this formula does not hold good for deoxyribose $C_5H_{10}O_4$, rhamnose $C_6H_{12}O_5$, rhamno heptose $C_7H_{14}O_6$, mannitol $C_6H_{14}O_6$. Some compounds which fit in this formula but not carbohydrates.

e.g. H–CHO, CH_3–COOH, H–$COOCH_3$.

These are also termed as saccharides (in Lattin Saccharum–sugar). They contains in the ratio 1 : 2 : 1. Carbohydrates are widely distributed in plants and animals. In the from of cellulose carbohydrates form the wood structures and fibres of plants. In the from of starch carbohydrates serves as the reserve food material for animals and humans. Carbohydrates are abundantly in rice, maize, potato, tuber, etc.

Definition : Carbohydrates are optically active polyhydroxy aldehydes or polyhydroxy ketones or other substances which produces these on hydrolysis are known as carbohydrates. They contain hydroxy group, ketone group, aldehyde group, hence these are polyfunctional compounds.

14.1.2 Classification of carbohydrates

I] Classification on the basis of smaller unit obtained on hydrolysis :

1. Monosaccharides or simple carbohydrates: These are simplest carbohydrates. They does not undergo further hydrolysis or does not divided into smaller unit. These are optically active (except dihydroxy acetone). These are basic unit of carbohydrates having general formula $(CH_2O)_n$. where n = 3 to 7 or 10. These are further classified on the basis of number of carbon atoms and functional group present in compounds.

i) Aldoses – These contains aldehyde group

a) Aldotriose – $C_3H_6O_3$

e.g. Glyceraldehyde (glycerose)

b) Aldotetrose – C_4HgO_4

e.g. Erythrose

c) Aldopentose $C_5H_{10}O_5$

e.g. Ribose

d) Aldohexose – $C_6H_{12}O_6$

e.g. Glucose

ii) Ketoses – These contains ketone group

a) Ketotriose – $C_3H_6O_3$

e.g. Dihydroxy acetone

b) Ketotetrose – C_4HgO_4

e.g. Erythrulose

c) Ketopentose $C_5H_{10}O_5$

e.g. Ribulose

d) Ketohexose – $C_6H_{12}O_6$

e.g. Fructose (laevulose)

2. Complex carbohydrates:

a) Oligosaccharides : These on hydrolysis gives two to ten monosaccharide units. e.g. $C_{12}H_{22}O_{11}$ Sucrose, Maltose, Lactose (Milk sugar),

Cellobiose.

These are divided by,

i) **Disaccharides:** These on hydrolysis gives two monosaccharide units. e.g. $C_{12}H_{22}O_{11}$ sucrose, maltose, lactose, cellobiose

Sucrose $\xrightarrow{\text{hydrolysis}}$ α –D–(+)– Glucose + β –D–(–) – Fructose (Hetero disaccharide)

Maltose $\xrightarrow{\text{hydrolysis}}$ α –D– (+)–Glucose + α –D–(+) – Glucose (Homo disaccharide)

Lactose $\xrightarrow{\text{hydrolysis}}$ β –D–(+)– Glucose + β –D–(+) – Galactose (Hetero disaccharide)

Cellobiose $\xrightarrow{\text{hydrolysis}}$ β –D–(+)– Glucose + β –D–(+) –Glucose (Homo disaccharide)

ii) **Trisaccharides:** These on hydrolysis gives three monosaccharide units.
e.g. $C_{18}H_{32}O_{16}$ raffinose.

Raffinose $\xrightarrow{\text{hydrolysis}}$ glucose + fructose + galactose

iii) **Tetrasaccharides:** These on hydrolysis gives four monosaccharide units e.g. $C_{24}H_{42}O_{21}$ stachyose.

Stachyose $\xrightarrow{\text{hydrolysis}}$ glucose + fructose + galactose + galactose.

b) **Polysaccharides:** These are neutral polymeric compounds, on hydrolysis gives large number of monosaccharide units. These are the polymer of monosaccharides. The common polysaccharides have general formula $(C_6H_{10}O_5)_n$, where n = 100 to 3000. e.g. $[C_6H_{10}O_5]_n$ Starch, cellulose, glycogen, gums.

Starch, glycogen $\xrightarrow{\text{hydrolysis}}$ n α –O–(+)– Glucose

Cellulose $\xrightarrow{\text{hydrolysis}}$ n β –O– (+)–Glucose

II] Classification on the basis of reducing property:

i) **Reducing sugar :** They reduce Tollen's reagent, Fehling's solution. e.g. Maltose, lactose, celloboise, glucose, fructose.

ii) **Non reducing sugar:** They do not reduce Tollen's reagent, Fehling's solution and Schiff's reagent. e.g. Sucrose.

14.1.3 Preparation of glucose:

It is prepared by following methods,

1. In laboratory from cane sugar (sucrose)
2. On large scale from starch (commercial method)

1. From sucrose (beet sugar or cane sugar) :

These on hydrolysis gives equimolar mixture of α –D– (+) – glucose and β –D–(–) fructose (Invert sugar). Sucrose is dextro rotatory but resulting mixture is laevorotatory. This is becaues laevo rotation of fructose(– 92.4°) is more than that of dextro rotation of glucose (+53°). The product is called invert sugar because on hydrolysis of sucrose, the sign of rotation is changed from (+)to (–).

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[323K]{90\%\ C_2H_5OH + \text{conc.HCl}} C_6H_{12}O_6 + C_6H_{12}O_6$$

2. From starch (potato or barley starch or dextrin) :

When starch is hydrolysed by dil. H_2SO_4 under 5 atm. pressure at 413K. gives glucose. It is a commercial method to prepare glucose.

$$[C_6H_{10}O_5] + nH_2O \xrightarrow[5\text{atm. pressure}]{\text{dil.}H_2SO_4\ 413K} nC_6H_{12}O_6$$

14.1. 4 Physical properties of glucose:

1. It is white crystalline solid and sweet in taste.
2. It has M.P. 419K.
3. It is soluble in water.
4. It is optically active and dextrorotatory. Hence named as dextrose. It has specific rotation + 53°.
5. All reducing sugar shows mutarotation. It is a phenomenon in which change in angle of rotation in neutral medium. The α –d glucose (+113°) and β –d glucose (+19°) to a constant final value of d–glucose is + 53°. Only reducing sugar show mutarotation.

14.1.5 Open chain structure of glucose:

From elemental analysis and molecular weight detremination experiments the molecular formula of glucose is $C_6H_{12}O_6$. Following reaction suggest the open chain structure of glucose.

1. Reduction: Glucose is reduced by HI gives n–hexane.

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} + 14(H) \xrightarrow{HI} CH_3(CH_2)_4CH_3 + 6H_2O$$

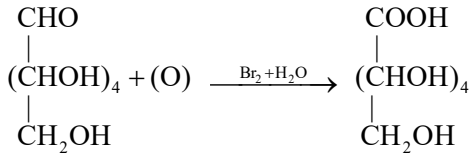
glucose n–hexane

This reaction shows that all six carbon atoms are linked in straight chain.

2. Oxidation:

i) By using mild oxidising agent i.e. bromine water or Ag_2O or Cu^{++} or NaOBr or NaOI.

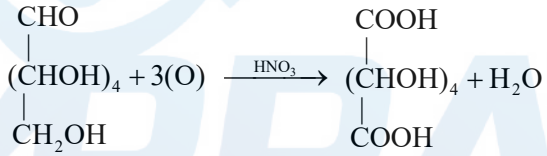
Glucose is oxidised by bromine water (mild oxidising agent) gives gluconic acid.



glucose gluconic acid

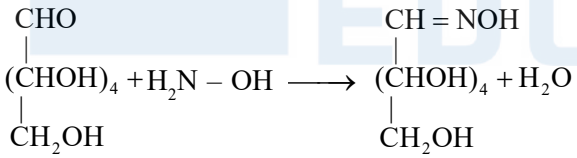
This reaction shows that carbonyl group present in glucose is aldehyde group.

ii) Byusing strong oxidising agent: Glucose is oxidised by dil. or conc. nitric acid (strong oxidising agent) gives saccharic acid or glucaric acid.



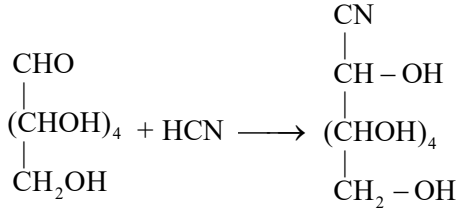
This reaction shows that primary alcoholic group present in glucose.

3. Reaction with hydroxyl amine: Glucose is reacted with hydroxyl amine gives glucose oxime.



glucose glucose oxime

4. Reaction with hydrogen cyanide : Glucose is reacted with HCN gives glucose cyanohydrine.

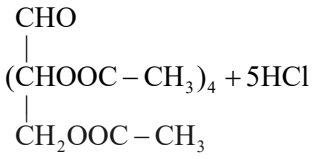


glucose glucose cyanohydrine

Reaction 3 and 4 confirm that aldehyde group present in glucose.

5. Acetylation (reaction due to OH group) :

Acetylation of glucose is carried out by using well known acetylating agents i.e. acetyl chloride and acetic anhydride. When glucose is reacted with acetyl chloride or acetic anhydride in the presence of anhydrous $ZnCl_2$ gives penta acetyl derivative i.e. glucose penta acetate or penta–o–acetyl glucose.



This reaction confirm the presence of five –OH groups present on different carbon atoms in glucose and also confirm open chain structure of glucose.

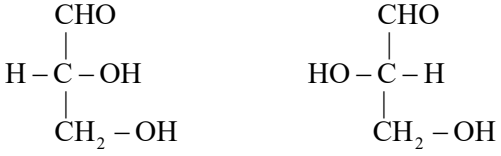
14.1.6 D and L configuration of monosaccharides:

The sugars are divided in to two types i.e. D–family and L–family.

In 1906 Rosanoff classify the two families on the basis of configuration by taking example of gluceraldehyde. He observed that glyceraldehyde can exist in two enatiomeric forms.

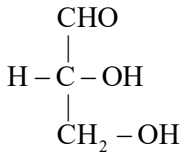
1. D – configuration : When –OH group is attached to right side adjacent to $–CH_2–OH$ group or last asymmetric carbon atom.

2. L–configuration: When –OH group is attached to left side adjacent to $–CH_2–OH$ group or last asymmetric carbon atom.

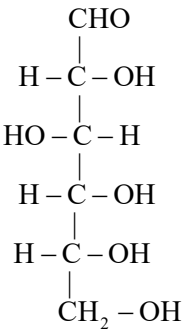


D– glyceraldehyde L– glyceraldehyde

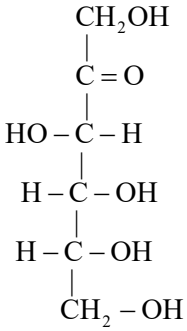
It has been found that all naturally occurring sugars i.e. glucose and fructose belong to D–series.



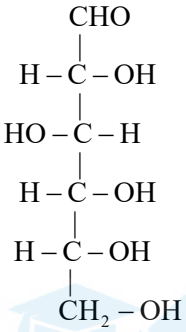
D–(+)–Glycerladehyde



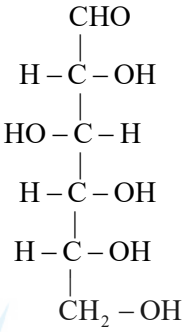
D–(+)–Glucose



D–(–) Fructose



D–(+)–Glucose



D–(+)–mannose

Note : It may be noted that D and L do not represent dextro and laevorotatory. The optical activity of molecule is represented by (+) and (–) sign.

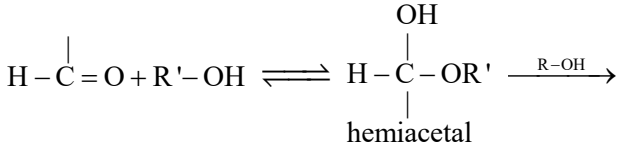
14.1.7 Cyclic structure of monosaccharides:

Open chain structure of monosaccharides do not give following reactions.

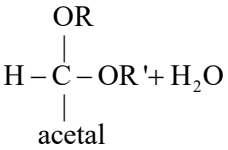
1. They does not gives condensation reaction with 2, 4 –ONP though the presence of aldehyde group.
2. They does not give addition reaction with $NaHSO_3$ though the presence of aldehyde group.
3. Glucose penta acetate do not react with NH_2OH though the presence of aldehyde group.
4. Glucose does not reduce Schiff's reagent though the presence of aldehyde group.

All above reaction indicates the absence of >C = O group in monosaccharides.

Cyclic structure can be studied when monosaccharides reacts with alcohols to form hemiacetals and acetals.



aldehyde



acetal

Monosaccharides contain a number of –OH groups aldehyde or ketone group. Therefore they can undergoes intramolecular reactions to form cyclic structures. For example, glucose form a six membered ring of five carbon atoms and one oxygen atom like pyran and fructose form five membered ring with four carbon atoms and one oxygen atom like furan.

Pyran

Furan

Anomers : These are cyclic structure of monosaccharides differ in configuration of –OH group around anomeric carbon atom.

If –OH group is at right side on anomeric carbon atom called as $-\alpha$, while –OH group is at left side on anomeric carbon atom called as $-\beta$.

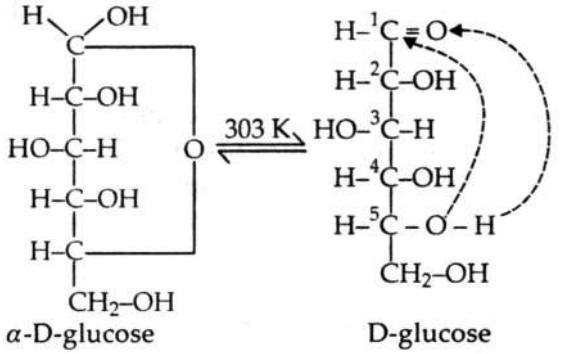
i) **Anomers of glucose :** Glucose is found to exist in two crystalline form.

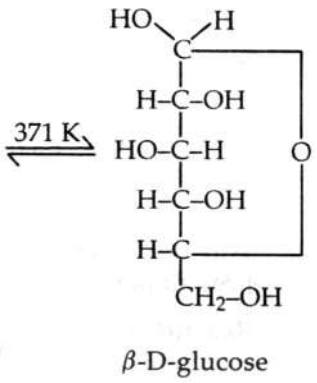
i.e. α –D– glucose and β –D–glucose called anomers.

a) Aqueous solution of glucose on crystalline at 303 K produces α – glucose

b) Aqueous solution of glucose on crystalline at 371 K produces β –glucose

The pair of optical isomers which differs in the configuration around Cl carbon atoms. Glucose form hemiacetal between. –CHO group and –OH group on C_5 atom. As a result Cl become asymmetric and form two isomers called $\propto$ –D–glucose and β –D–glucose. These two isomers differs in the orientation of Hand OH around Cl atom called anomers. When –OH group present on anomeric carbon atom at right side called α , while –OH group present on anomeric carbon atom at left side called β.



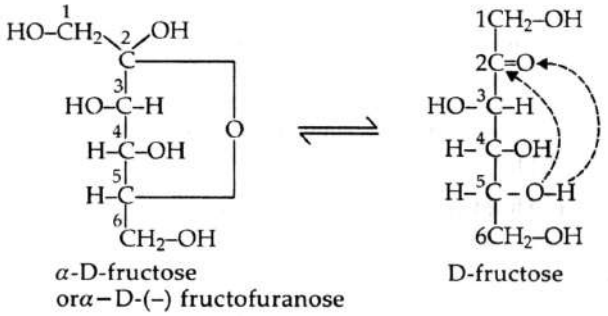


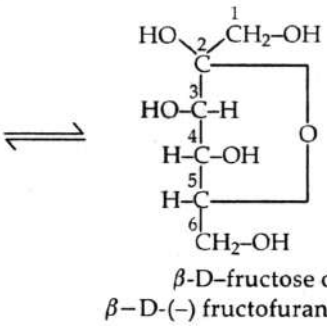
Note:

1. Anomers are six membered five carbon atom with one oxygen atom cyclic structures of glucose, in which –OH of C_5 is involved in ring formation.
2. This ring structure explain the absence of –CHO group in glucose.
3. Cl carbon in aldehyde carbon before cyclilisation is called anomeric carbon.

ii) Anomers of fructose:

Fructose has molecular formula $C_6H_{12}O_6$ and ketonic group at a carbon 2. It is belongs to D–series and laevorotatory compound, hence it is written as D– (–) – fructose. Fructose form hemiketal between > C = O and –OH group of C_5 atom. As a result C_2 atom become asymmetric and form two isomers called α –D–fructose and β –D–fructose. These two isomers differs in the configuration of H and –OH around C_2 atom called anomers.





Note : Anomers are five membered four carbon atom, one oxygen atom cyclic structure, in which –OH of C_5 involved in ring formation.

Conversion of Fischer projection formula of sugers into Haworth projection formula:

Rules for Haworth projection formula :

i) Draw the hexagonal or pentagonal ring with its oxygen atom at top.

ii) The terminal $–CH_2–OH$ group is always placed above the plane of hexagonal or pentagonal ring in D–series and below the hexagonal or pentagonal ring in L–series

iii) Place all the groups (on C_2, C_3 and C_4) which are present left hand side in Fischer projection formula above the plane of the hexagonal or pentagonal ring in both the series sugar.

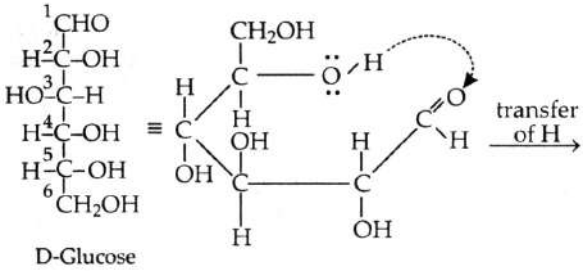
iv) Place all the group (on C_2, C_3 and C_4) which are present right hand side in Fischer projection formula, below the plane of the hexagonal or pentagonal ring in both the series sugar.

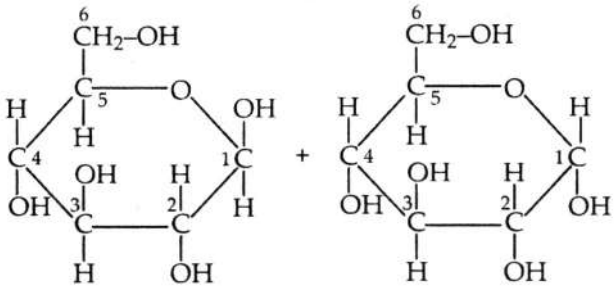
v) **For D–series carbohydrates:** (a) If –OH group is up the configuration of anomeric carbon is β and (b).

If OH group is down the configuration of anomeric carbon is α .

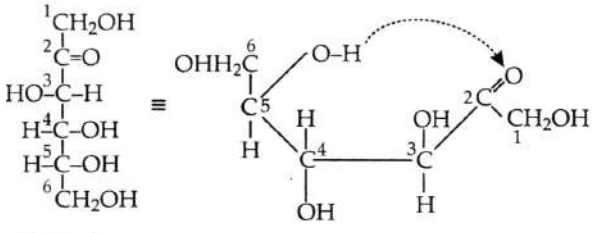
vi) **For L–series carbohydrates:** (α) If –OH group is up the configuration of anomeric carbon is a and (b) If –OH group is down the configuration of anomeric carbon is β .

e.g. 1. Hawoth Structure of glucose:

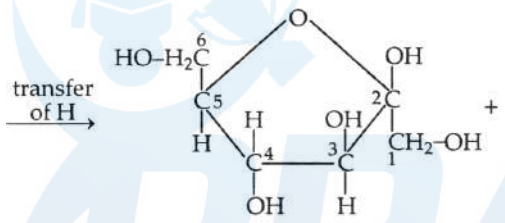




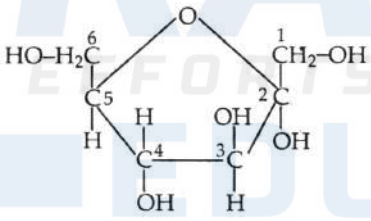
2. Hawoth Structure of Fructose : Fructose is made by isomerisation of glucose.



D-Fructose



β-D-(–) fructofuranose(Cis)



α-D-(–) fructofuranose(Trans)

14.1.8 Structures of disaccharides :

All disaccharides have molecular formula $C_{12}H_{22}O_{11}$ (Sucrose, maltose, lactose and celloboise). These on hydrolysis gives two monosaccharide units. Sugar whose name ends with suffix 'oside' is non reducing sugar while ends with 'ose' is reducing sugar.

1. Structure of sucrose: These on hydrolysis gives equimolar mixture of α – D– (+) – glucose and β – D–(–) fructose. Sucrose is dextro rotatory but resulting mixture is laevorotatory.

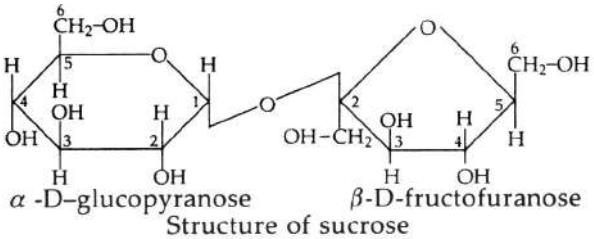
$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose α –D–(+) – glucose β –D–(–) fructose

In cyclic structure, two monosaccharides are held together by a glycosidic linkage (acetal bond) between C_1 of α –glucopyranose (α –glucose) and C_2 of β –fructofuranose (β –fructose). Since the reducing groups of glucose and fructose are involved in glycosidic bond formation, Hence sucrose is non reducing sugar. (+) sucrose is named equally well as either.

α –D–glucopyranosyl β –D–fructofuranoside or

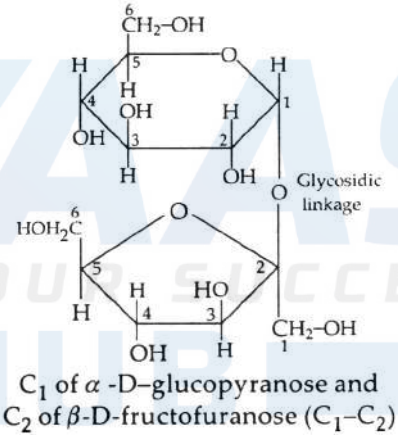
β –D–fructofuranosyl α –D–glucopyranoside.



α -D–glucopyranose β-D-fructofuranose

Structure of sucrose

OR



C_1 of α -D–glucopyranose and C_2 of β-D-fructofuranose (C_1–C_2)

Thus sucrose contain $1 \rightarrow 2$ α –β glycosidic linkage.

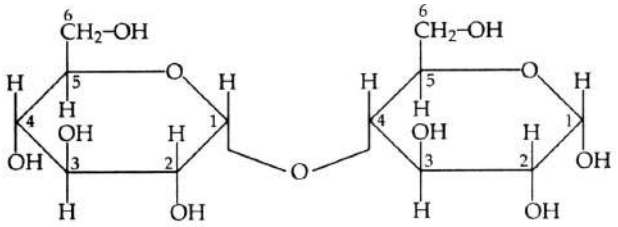
2. Structure of maltose (4–O– α –D–Glucopyranosyl D–glucopyranose) : It is obtained by partial hydrolysis of starch. These on hydrolysis gives two molecules of α –D–glucose.

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow 2C_6H_{12}O_6$$

α –D–glucose

In cyclic structure, two α –D–glucopyranose molecules are held together by glycosidic linkage between C_1 of one glucopyranose molecule and C_4 of another glucopyranose molecule. The free aldehyde group can be produced at C_1 of second

glucopyranose molecule. Hence maltose is reducing sugar.



α –D–glucopyranose α –D–glucopyranose

Structure of maltose

C_1 of (I) glucopyranose and C_4 of (II) glucopyranose (C_1–C_4)

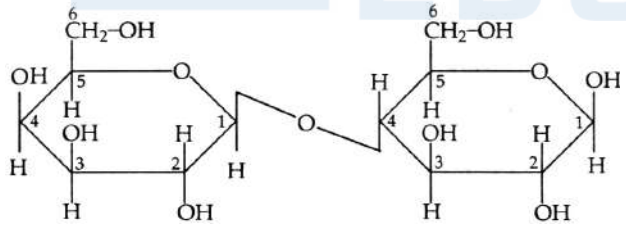
Thus maltose contain $1 \rightarrow 4\alpha - \alpha$ glycosidic linkage.

3. **Structure of lactose (4–O–β–D–Galactopyranosyl D–glucopyranose) :** These on hydrolysis gives β–D–glucose and β–D–galactose. It is known as milk sugar.

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

β–D –glucose β–D –galactose

In cyclic structure, two monosaccharide units are held together by glycosidic linkage between C_4 of β–glucopyranoseand C_1 of β–D–galactopyranose. The free aldehyde group produce at β–D–glucopyranose molecule. Hence lactose is reducing sugar.



β–D–galactose β–D–glucose

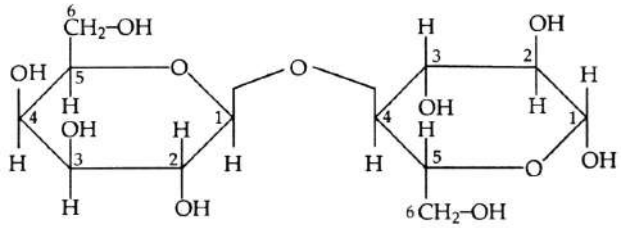
Structure of lactose

C_1 of β–D–galactopyranose and C_4 of β–Dglucopyranose (C_4–C_1)

Thus lactose contain $1 \rightarrow 4\beta - \beta$ glycosidic linkage.

OR

According to Board Book

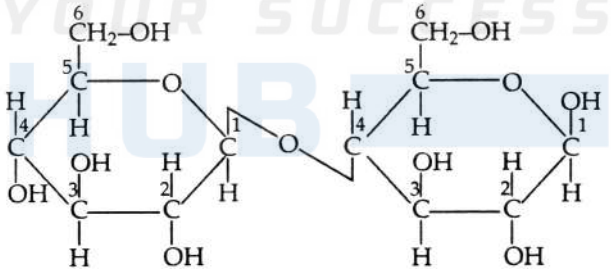


4. **Structure of celloboise (4–O–β–D–Glucopyranosyl D–glucopyranose) :** Celloboise is obtained by partial hydrolysis of cellulose.

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

celloboise β–D–glucose β–D–glucose

In cyclic structure of celloboise C_1 of one β–D–glucopyranoseis linked to C_4 of another β–D–glucopyranose by glycosidic linkage. Thus celloboise contain $1 \rightarrow 4\beta - \beta$ glycosidic linkage. It is a reducing sugar because –CHO group at C_1 in second glucose molecule.



Structure of celloboise

C_1 of β–D–glucopyranose and C_4 of β–Dglucopyranose i.e C_1–C_4 bond

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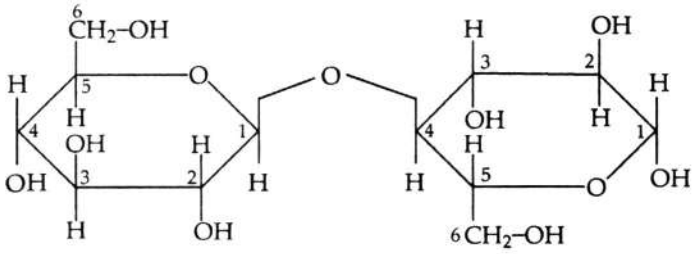


14.1.9 Structure of polysaccharides

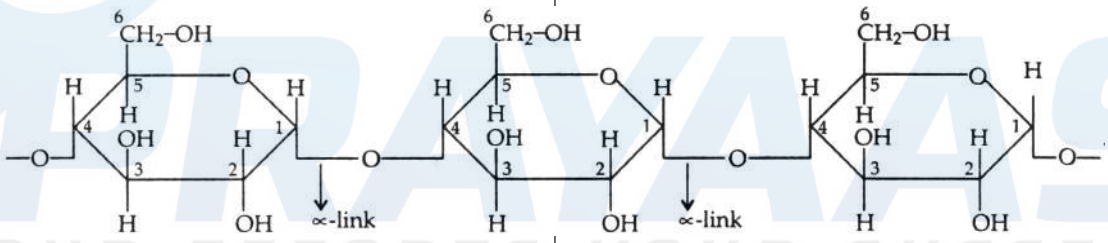
All polysaccharides have molecular formula $(C_6H_{10}O_5)_n$. These on hydrolysis gives number of monosaccharide units. In polysaccharides large number of monosaccharides units are joined together by glycosidic linkage.

1. **Structure of starch:** It is main storage polysaccharide of plants. High content of starch is found in cereals, roots, tubers and in some vegetables. Which on hydrolysis gives number of α –D–glucose.

$$(C_6H_{10}O_5)_n + nH_2O \longrightarrow n\ C_6H_{12}O_6$$

α –D–glucose

Starch is polymer of α –D–glucose and consist of two components amylose and amylopectin. **Amylose :** It is water soluble, which consist about 15 to 20% starch. Chemically amylose is long unbranched chain polymer with 200–1000 α –D–glucopyranose units held by C_1–C_4 glycosidic linkage.

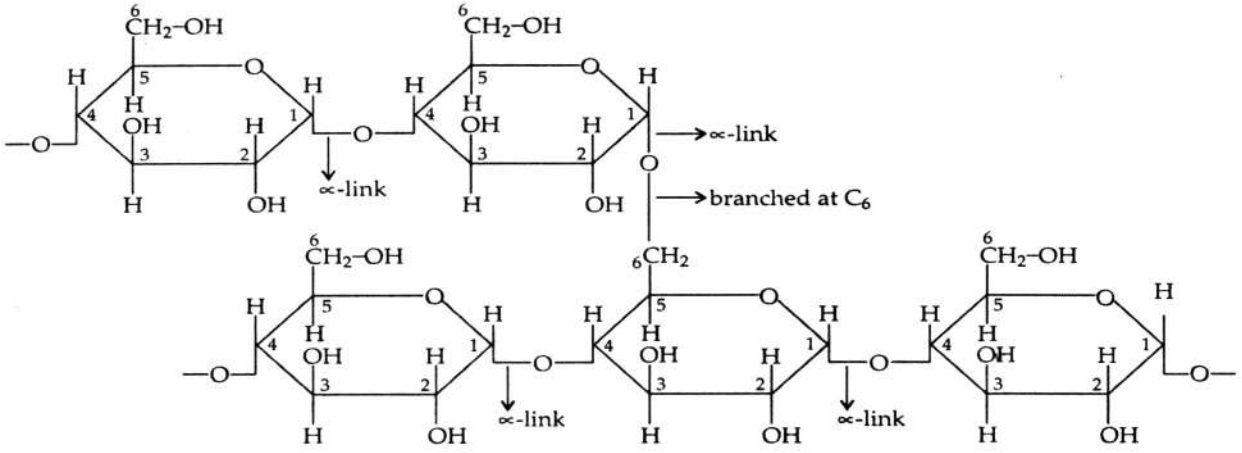


Amylose

(C_1–C_4 glycosidic linkage)

Thus amylose contain 1 $\rightarrow$ 4 α – α glycosidic linkage like maltose.

Amylopectin: It is water insoluble, which consist about 80 to 85% starch. It is a branched chain polymer of α –D–glucopyranose units, held together by C_1–C_4 glycosidic linkage, whereas branching occurs at C_1–C_6 glycosidic linkage.



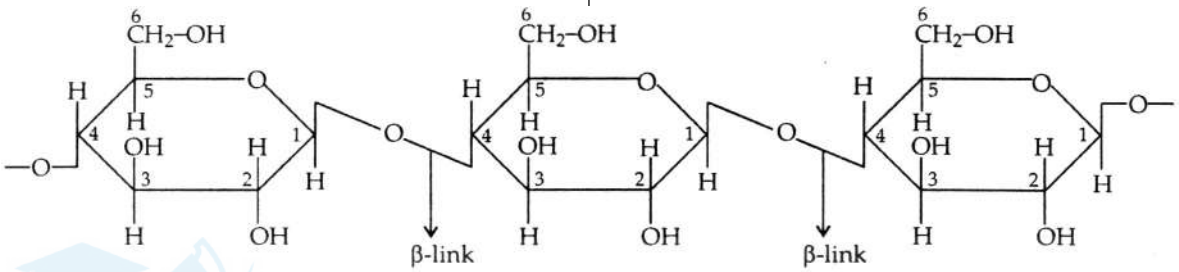
Thus amylopectin contain $1 \rightarrow 4\ \alpha - \alpha$ glycosidic linkage in long chain and $1 \rightarrow 6\ \alpha - \alpha$ glycoside in branched

2. **Structure of cellulose:** It is most abundant substance in plant. It is present in cell wall of plant cell. It isstraight chain polysaccharide, which on hydrolysis gives number of β–D–glucose. Hence it is a polymer of β–D–glucose.

$(C_6H_{10}O_5)_n + n\ H_2O \longrightarrow n\ C_6H_{12}O_6$

Cellulose β–D–glucose

In cyclic structure of cellulose ,number of β–D–glucopyranose units are joined by glycosidic linkage between C_1 of one β–D–glucopyranose and C_4 of another β–D–glucopyranose molecule.



Cellulose

(C_1 of (I) β–D–glucopyranose and C_4 of another β–D–glucopyranose)

Thus cellulose contain $1 \rightarrow 4\ \beta - \beta$ glycosidic linkage.

3. **Glycogen:** It is a animal polysaccharide found in brain muscle and liver. It serves as reserve carbohydrates for animal and hence known as animal starch. It's structure is similar to amylopectin and highly branched. It is also found in yeast and fungi.

14.1.10 Importance of carbohydrates:

1. It act as main source of energy
2. It act as storage of energy for the functional of living organism.
3. They form structural material for cell walls.
4. Cellulose in the form of cotton, used in textiles, papers.
5. Two aldopentose i.e. D–ribose and 2–deoxy D–ribose are present in nucleic acid, which involves biosystem in combination with proteins and lipids.

Section– II : Proteins

14.2.1 Definition:

Proteins are naturally occurring nitrogenous polypeptide compounds, which on hydrolysis gives various number of L– α –amino acids.

14.2.2 Acid hydrolysis of proteins:

In 1900 German chemist Emil Fisher studied the structure of protein. He observed that, proteins are completely hydrolysed by acids (25 % HCl or 35% H_2SO_4) or alkalies gives mixture of various number of L– α –amino acids.

It is clear that α –amino acids are fundamental unit of proteins.

Proteins are condensation biopolymer of α – amino acids and have molecular weight above 10,000.

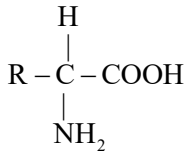
$-[-HN-CHR-CO-]_n + nH_2O \xrightarrow{H^+}$

$nH_2N-CHR-COOH$

14.2.3 Elementary idea of amino acids:

1. **Amino acids :** These are derivatives of carboxylic acids obtained by replacing H atom by $-NH_2$ group.

These are organic compound containing both –COOH and $-NH_2$ functional group are known as amino acids.



2. Classification: Depending upon position of amino group. These are classified as α, β, γ, δ and so on amino acids. Only α –amino acids obtained by hydrolysis of proteins. Generally all naturally occurring amino acids are a–amino acids. (NH_2 group present on α –carbon atom).

3. Classification of α –amino acids : These are classified as

i) Neutral α –amino acids : They contains equal number of –COOH and $–NH_2$ group.

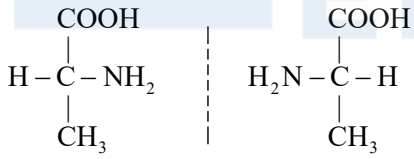
ii) Acidic α –amino acids : They contains more number of carboxyl group than amino group.

iii) Basic α –amino acids: They contains more number of amino group than carboxyl groups.

iv) Essential α –amino acids: These are not synthesized in the body but obtained through diet. e.g. Valine, lysine etc.

v) Non–essential α –amino acids: These are synthesized in the body.
e.g. Glycine, serine, proline

4. L–family α –amino acids : All α –amino acids are optically active except glycine. They exist both D and L–forms.The 'D' refer to the isomer with $–NH_2$ group at right side and 'L' refer to the isomer with $–NH_2$ group at left side. All naturally occurring α –amino acids are belong to L–series.



D–alanine L–alanine

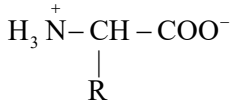
5. Physical properties of α –amino acids:

i) These are colour less crystalline solid.

ii) All are optically active except glycine.

iii) These are soluble in water.

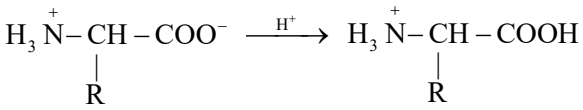
iv) In aqueous solution, the –COOH group can lose a proton and $–NH_2$ group can accept proton giving rise to dipolar ion (zwitter ion).



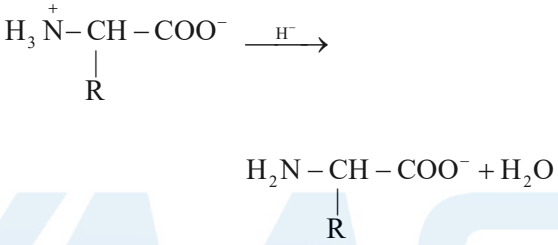
(zwitter ion)

v) In zwitter ionic form, α –amino acid shows amphoteric behavior as they react with both acids and bases.

a) When acid is added to α –amino acid $–COO^-$ accept proton and therefore, the basic nature is due to $–COO^-$ group. In acidic medium a–amino acid act as cation. When electric field applied, they migrate towards cathode.



b) When alkali is added to α –amino acid, $–NH_3^+$ group release proton and therefore acidic character is due to $–NH_3^+$ group. In basic medium α –amino acid act as anion. When electric field applied, they migrate towards anode.



Note:

1) Thus in aqueous solution the basic character of α –amino acids is due to $–COO^-$ group and acidic character is due to $–NH_3^+$ group.

2) Aqueous solution of neutral α –amino acid is slightly acidic because acidic character of $–NH_3^+$ group is more than that of basic character $–COO^-$ group.

6. Isoelectric point of α – amino acids : In certain H^+ ion concentration (pH), the dipolar ion exist as a neutral ion and does not migrate towards anode and cathode is known as isoelectric point. At isoelectric point, amino acids are less soluble in water, and this property is used for separation of different amino acids obtained from hydrolysis of proteins.

14.2.4 Classification on the basis of structure and solubility:

a) Fibrous proteins (structural proteins or sclero proteins) : Long helical structure (α –form) insoluble in water, acids and alkalies. They serve as, chief structural material for tissue. e.g. Keratin in hair, nail and wool, myosin in muscle,

collagen in tendons and bones, silk, feathers, horns, hooves, skin, cartilage, elastin in ligaments etc.

b) Globular proteins: These are spherical, elliptical or oval shape and soluble in water, base, acid and salt.They are involved in the maintenance and regulation of life process. They are folded to form spherical shape and have weak intramolecular hydrogen bonding and weak intermolecular forces than fibrous proteins e.g. Albumin, globulin, protamine, prolamine, histone, glutelin, thyroglobin, insulin, heamoglobin, casein of milk, all enzymes, venoms of snakes, scorpion, bees etc.

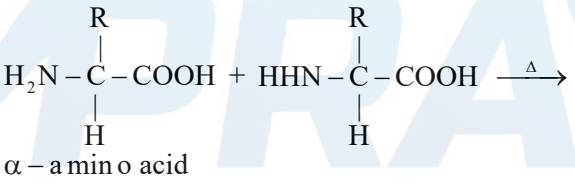
14.2.5 Peptide linkage (peptide bond) :

Definition:

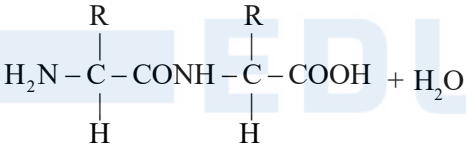
–(CO–NH)– linkage in protein is known as peptide linkage. It is planar in which oxygen and hydrogen are at trans position.

Formation of peptide linkage:

Peptide linkage in protein is formed by free $-NH_2$ group of one α –amino acid is joined with free –COOH group of another α –amino acid by elimination of water molecule.



α – amino acid



dipeptid

Depending upon the number of amino acids residues per molecule, the peptides are called as dipeptide (one peptide linkage), tripeptide (two peptide linkage), tetrapeptide (three peptide linkage), etc. The formation of peptide bonds can continue until a molecule containing thousands of amino acids. Relatively shorter pep tides are called, oligopeptides. While, larger polymer are called, polypeptides or proteins. By convention a peptide having molecular mass up to 10,000 is called polypeptide. While, a peptide having molecular mass more than 10,000 is called proteins.

14.2.6 Structure of proteins:

Structure and shape of proteins can be studied at four different level. i. e. primary, secondary, tertiary and quaternary. Each level being more complex than previous one.

1. Primary structure of proteins :

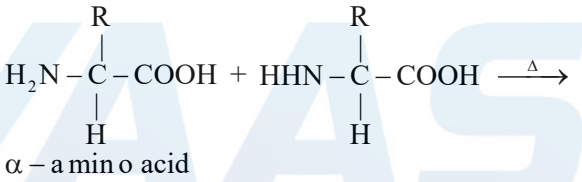
In primary structures of proteins number of α –amino acid are linked together in linear sequence by peptide bond.

Each molecule of α –amino acid of a given protein has the same sequence along with polypeptide chain.

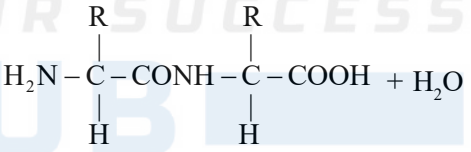
Any change in this primary structure i.e. the sequence of α –amino acids creates a different protein.

The primary structure of protein is determined by its successive hydrolysis with enzymes or acids or alkalies.

Proteins $\rightarrow$ 1° – proteoses $\rightarrow$ 2°–proteoses $\rightarrow$ pep tones $\rightarrow$ polypeptides $\rightarrow$ simple peptide $\rightarrow$ α –amino acids.



α – amino acid



dipeptid

2. Secondary structure of proteins

Secondary structure is arise due to folding or arrangement of polypeptide chain.

Secondary structure of protein is divided in to two types depending upon size of R–group.

a) α –helix structure:

When intramolecular hydrogen bonding takes place between –NH group of one unit and carbonyl oxygen atom of fourth units then the chain of α –amino acids coils at right hand side called α –helix.

Intramolecular hydrogen bonding between same unit is responsible for holding helix in a position.

b) β–pleated structure:

This structure is formed when polypeptide chains are arranged in a zig–zag manner with alternate bulky R–group on same side. The chains are held together by a very large number of intermolecular as well intramolecular hydrogen bonds between > C = O and –NH of different chains. This results the formation of flat sheet.

These sheets can slide over each other to form three dimensional structure called as β–pleated structure e.g. Fibroin of silk.

3. Tertiary structure of proteins:

The tertiary structure is formed due to folding, refolding, coiling and bonding of polypeptide chain producing three dimensional structure. This structure gives the overall shape of proteins e.g. Fibrous and globular proteins.

The main forces which stabilize the secondary and tertiary structure of proteins are hydrogen bonds, disulphide linkage, Vander Waals force and electrostatic force of attraction (ionic bond).

4. Quaternary structure of proteins:

Proteins that have more than one peptide chain are known as oligomers. The individual chains are called subunits.

The subunits are held together by hydrogen bonding, electrostatic attractions, hydrophobic interactions etc. Quarternary structure explains the way the sub units are arranged in space.

14.2.7 Denaturation of proteins:

The structure of natural proteins is responsible for their biological activity. These structures are maintained by various attractive forces i.e. hydrogen bonding, Vander Waals force, sulphide bond, ionic bond etc.

The breaking of these attractive forces by physical or chemical method, proteins lose its biological activity called as denaturation of proteins.

During denaturation secondary and tertiary structures are destroyed but primary structure remain intact.The peptide bond does not break.

e.g. i) Coagulation of egg white by heat.
ii) Curdling of milk which is caused due to formation of lactic acid by the bacteria present in milk.
iii) Formation of chease from milk.

Section–III: Lipids

14.3 : LIPIDS

1. Definition:

These are oily ,fatty ,waxy substancse of plants, animals and tissues which are insoluble in water and soluble in organic solvent like $CHCl_3$, CCl_4, ethers, benzene etc are called lipids.

e.g. Oils, fats, phospholipids, steriods, glycolipids, lecithin, cephalin, cholestrol, lanosterol etc.Lipids are mainly made from carbon, hydrogen and oxygen. The number of oxygen molecules molecules are always small as compare to carbon. They also contain P, N, S.

Lipids serve as energy reserve for use in metabolism and as a major structural material in cell membranes for regulating the activities of cell and tissues.

2. Classification of lipids:

These are classified on the basis of product obtained on hydrolysis,

I) Complex or compound lipids,
II) Simple lipids

I) Complex or compound lipids:

They have ester linkage and on hydrolysis gives fatty acids, alcohols, phosphoric acid and nitrogen containing base e.g. Oils, fats, phospholipids, glycolipids, waxes.

(a) Oils and Fats:

Introduction:

These are naturally occurring tasteless, odourless, colourless, nonvolatile liquids or solids, lighter than water, lesspolar compounds. These are insoluble in water and soluble in nonpolar solvent like CCl_4, ethers. These are termed as natural lipids.

Fats are stored energy source and act as heat insulator for the loss of heat from body.

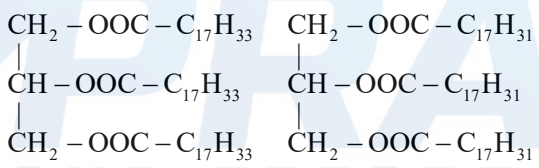
Preparation of triglycerides (glyceride or triacyl glycerol (TAG) or oils or fats) :

When glycerol (glycerine) is heated with fatty acid gives triglycerides. Triglyceride has wide application in preparation of soap, paints, varnishes, ink, ointments and cream.

$$\begin{array}{l} CH_2-OH \\ | \\ CH-OH \\ | \\ CH_2-OH \end{array} \begin{array}{l} HOOCR \\ + \\ HOOCR \\ \\ HOOCR \end{array} \longrightarrow \begin{array}{l} CH_2-OOCR \\ | \\ CH-OOCR \\ | \\ CH_2-OOCR \end{array} + 3H_2O$$

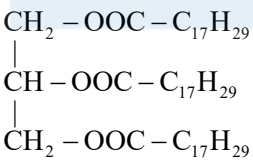
Important definitions:

1) **Glycerol:** It is trihydroxy alcohol, obtained by replacing three hydrogen atoms from propane by three – OH groups. It is water soluble, nontoxic, viscous, hygroscopic, high boiling point liquid.
2) **Fatty acids :** Long chain higher monocarboxylic acids are known as fatty acids.
3) **Saturated fatty acids ($C_nH_{2n}O_2$) :** Long chain higher monocarboxylic acids containing carboncarbon single bond.
   e.g. Stearic acid $C_{17}H_{35}COOH$
4) **Unsaturated fatty acids :** Long normal chain higher monocarboxylic acids containing carboncarbon multiple bond.
   e.g. Oleic acid $C_{17}H_{33}COOH$ (1 C = C bond)
5) **Triglycerides :** These are triesters of glycerol with fatty acids. The fatty acid in triglyceride contain an even number of carbon atoms and an unbranched carbon chain.
6) **Oils:** These are triglycerides of unsaturated fatty acids.
   e.g.



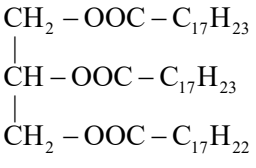
Glycerol trioleate or triolein

Glycerol trilinoleate

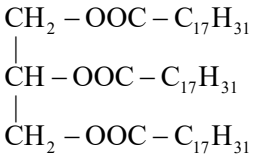


Glycerol trilinoleate

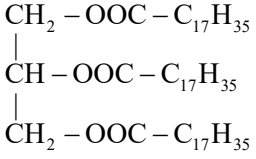
7) **Fats:** These are triglycerides of saturated fatty acids.



Glycerol trilaurate



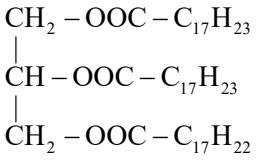
Glycerol tripalmitate



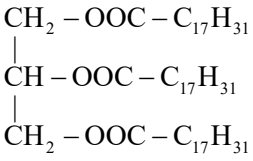
Glycerol trioleate or triolein

3. **Classification of triglycerides (oils or fats) :**

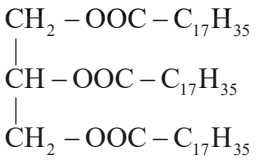
i) **Simple triglycerides :** When three –OH groups of glycerol are replaced by three same fatty acids then these are known as simple triglycerides.



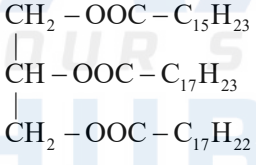
Glycerol trilaurate



Glycerol tripalmitate



ii) **Mixed triglycerides :** When three –OH groups of glycerol are replaced by three different fatty acids then these are known as mixed triglycerides.
   e.g.



Glycerol palmito stero oleate.

(b) Phospholipids: It is a mixed glyceride of higher fatty acid and phosphoric acid in which two –OH group of glycerol are esterified by fatty acids while third –OH group of glycerol is esterified by phosphoric acid. e.g. Lecithins, cephalins etc.

(c) Glycolipids: Lipids may be associated with sugar to form glycolipids. The sugar is typically glucose or galactose.The animal glycolipids is glycocerebroside. The plant glycolipid is galactocerebroside.

(d) Waxes: They provide waterproofing on leaves, fruits, berries, animal fur and feather of birds. These are mainly esters of long chain carboxylic acid with long chain monohydric alcohols.

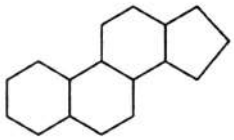
II) Simple lipids:

They donot have ester linkage and can not be hydrolysed.

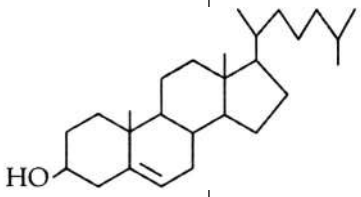
e.g. Steroids like cholesterol, terpens, prostaglandins, fats soluble vitamins like A, D, E, K.

These are divided in to three types.

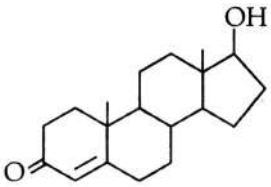
1. **Steroids:** These are derived from cydopentaperhydrophenanthrene, which has nucleus of four rings.



steroid nucleus



cholesterol (a sterol)



testosterone (an androgen)

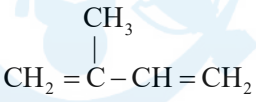
e.g. Animal sterols (Zoosterols) : It includes male sex hormone (cholestrol, lansosterol, testosteron, androsteron), Female sex hormons (estrogen, estron, estradiol)

Plant sterols (Phytosterols) : It includes β – Sisosterol.

Fungal sterols (Mycosterols) : It includes ergosterol

2. **Terpens:** These are unsaturated hydrocarbon which consist of number of isoprene units.

e.g. Geraniol, menthol, phytol, vitamin A, D, E, K.



These are classified on the basis of number of isoprene units (Each isoprene units contain 5 carbon atoms)

No. of C - atoms	10	15	20	30	40
Class	Monoterpene	Sesquiterpene	Diterpene	Triterpene	Tetraterpene
Examples	α-phellandrene	Abscisic acid	Cembrene	Squalene	β-Carotene

3. **Prostaglandins:** These are group of C_{20} lipids that contain a five membered ring with two long side chain. They may be detected in many body tissues.

Uses of lipids:

1) **Fats and oils :** Have a convenient and concentrated storing food energy in plants and animals. Although carbohydrates also serve as source of readily available energy, equal mass of fat produce over twice the amount of energy than carbohydrates.

2) **Glycolipids:** These are components of cell membrane. Glycolipids occur in bacterial cell wall. In plants, glycolipids are principal lipid constituents of chloroplasts. Cerebrosides are animal glycolipids that are found in plasma membranes of neural tissues and are abundant in myelin sheath of neurons.

3) **Phospholipids:** They form membrane like structure in water. Phospholipids and sterols like cholesterol are major components of cell membranes.

4) **Waxes:** They provide vital waterproofing for body surfaces. Waxes are water repelling solids that are protective coatings on leaves, fruits, berries, animal fur and feather of birds.

5) **Steroids:** It include adrenal hormones, sex hormones and bile acids. Lipids can combine with proteins to form lipoproteins, found in cell membranes. Bile acids are steroids which related to digestion of fat in intestine. Cholic acid an example of bile acids. Prostaglandins have a wide range of biological effects.

6) **Terpenes:** It include vitamin A, E and K and phytol. Terpenes occur in essential oils such as menthol and camphor. Terpenes are the main constituents of the essential oils secreted by the glands of certain aromatic plants.

e.g. **Myrcene** (oil of bayberry), Limonene (oil of lemon), β–pinene (oil of turpentine), geraniol (oil of roses), menthol (peppermint), zingiberene (oil of ginger), caryophyllene (oil of cloves) and squalene (shark liver oil).

7) Prostaglandins can lower blood pressure, affect blood platelet aggregation during clotting, lower gastric secretion and stimulate uterine contractions during child birth.

Section–IV Enzymes

14.4 ENZYMES

Definition: These are proteins, produced by living system and catalyse specific biological reactions are called enzymes.The enzymes differs from other catalyst in being highly selective and specific.

e.g. Maltose is hydrolysed in to glucose by maltase enzyme,

$$C_{12}H_{12}O_{11} \xrightarrow{\text{maltase}} 2\ C_6H_{12}O_6$$

maltose glucose

Mechanism of enzyme action:

Enzymes are needed in small quantity for the progress of reaction. Similar to the action of chemical catalyst, enzyme reduce the magnitude of activation energy and increase the rate of reaction mechanism.

Step–i: Binding of enzyme to substrate to form activated complex

$$E + S \rightleftharpoons ES$$

Step–ii: Formation of product in the activated complex

$$ES \longrightarrow EP$$

Step–iii: Decomposition of EP in to enzyme and product

$$EP \longrightarrow E + P$$

Section–V: Nucleic Acids

14.5 NUCLEIC ACIDS

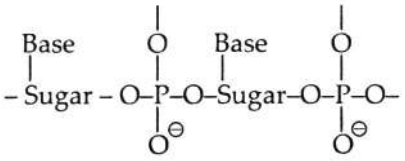
Nucleus of the living cell is responsible for the transmission of inherent character known as heredity. The nucleus of a cells are made from nucleoprotein which contain two types of nucleic acids.

1) Deoxyribonucleic acid (DNA)
2) Ribonucleic acid (RNA)

Chemical composition of nucleic acids

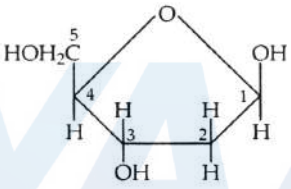
Nucleic acid (DNA or RNA) on complete hydrolysis gives pentose sugar, phosphoric acid, nitrogen containing heterocyclic compound (called base).

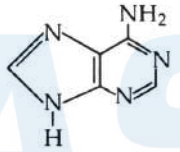
In nucleic acid the sequence is Base–Sugar– Phosphate.This sequence is known as nucleotide.

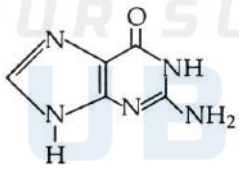


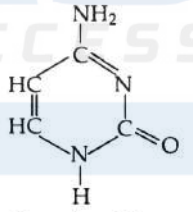
1. Deoxyribonucleic acid (DNA)

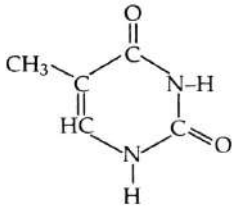
It on hydrolysis gives β–D–2–deoxyribose (pentose sugar), four bases i.e. adenine (A),cytosine (C), guanine (G) and thymine (T) i.e (ACGT) and phosphoric acid.The β–D–2–deoxyribose means no –OH group at C_2 position.


β-D-2–deoxyribose


Adenine (A) Purine base

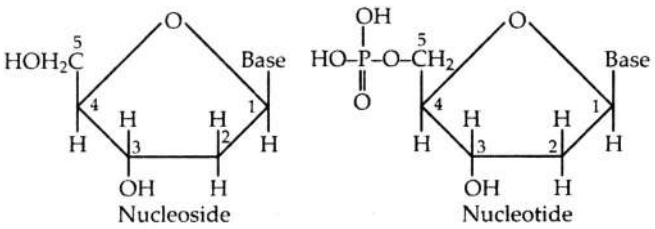

Guanine (G) Purine base


Cytosine (C) Pyrimidine base

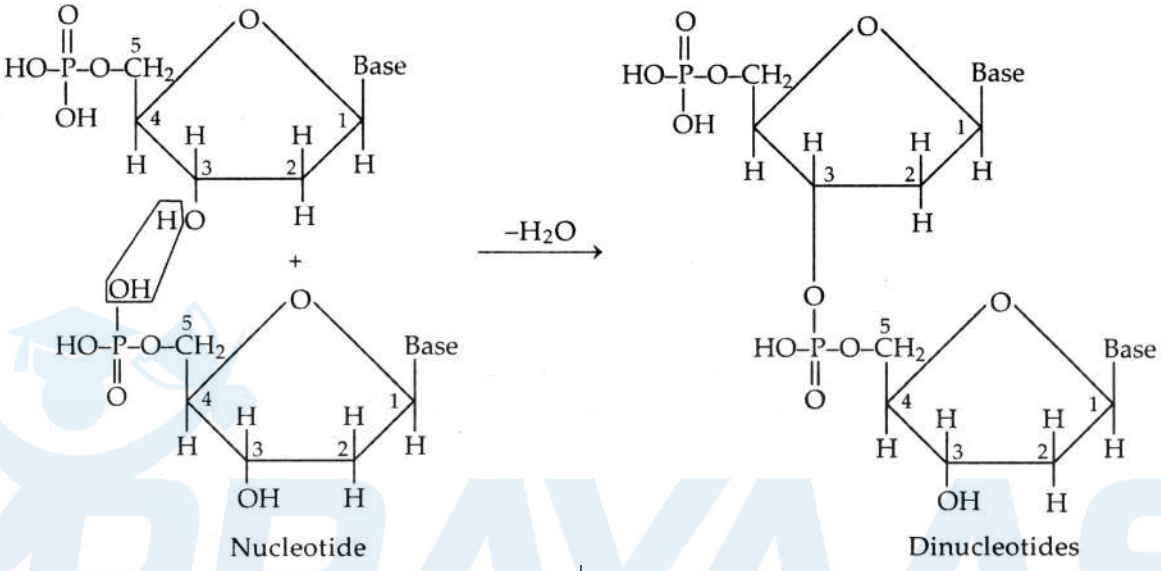

Thymine(T)

a) Primary structure of DNA:

When base is attached to position 1 of the pentose sugar is known as Nucleosides. When nucleosides link to phosphoric acid at position 5 of a pentose sugar is known as Nucleotides.



The two nucleotides are joined together by phospho diester linkage between C–3 of one nucleotide and C–5 of another nucleotide to form dinucleotides.

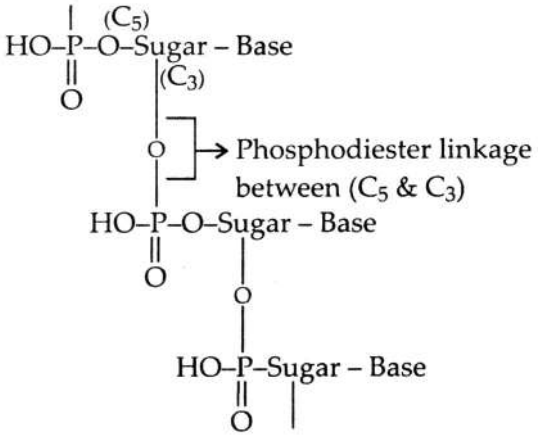


When number of nucleotides are condense together to form very long chain of polynucleotide or DNA

b) Secondary structure of DNA:

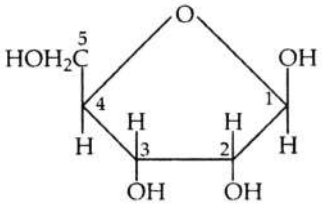
When two nucleic acid chains are wound about each other and held together by hydrogen bond between pairs of base. Adenine (A) form hydrogen bond with thymine (T) i.e. A– T, and cytosine (C) form hydrogen bond with guanine (G). i.e.C–G. This double strand helix structure is known as DNA.

The simplified version of nucleic acid chain is shown as,

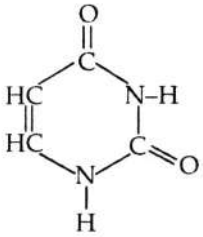


2. Ribonucleic acid (RNA) :

It on hydrolysis gives β –D–ribose (pentose sugar), four bases i.e. adenine (A), cyctosine (C), guanine (G) and uracil (U) i.e. (ACGU) and phosphoric acid



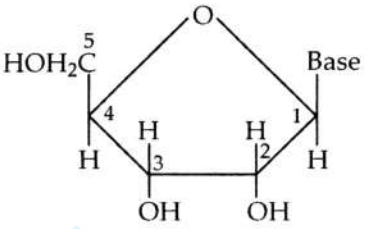
β –D–ribose



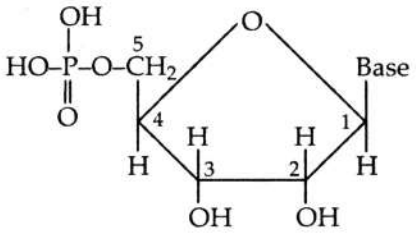
Uracil (U) Pyrimidine base

When base is attached to position 1of the pentose sugar is known as Nucleosides.

When nucleosides link to phosphoric acid at position 5 of a pentose sugar is known as Nucleotides.

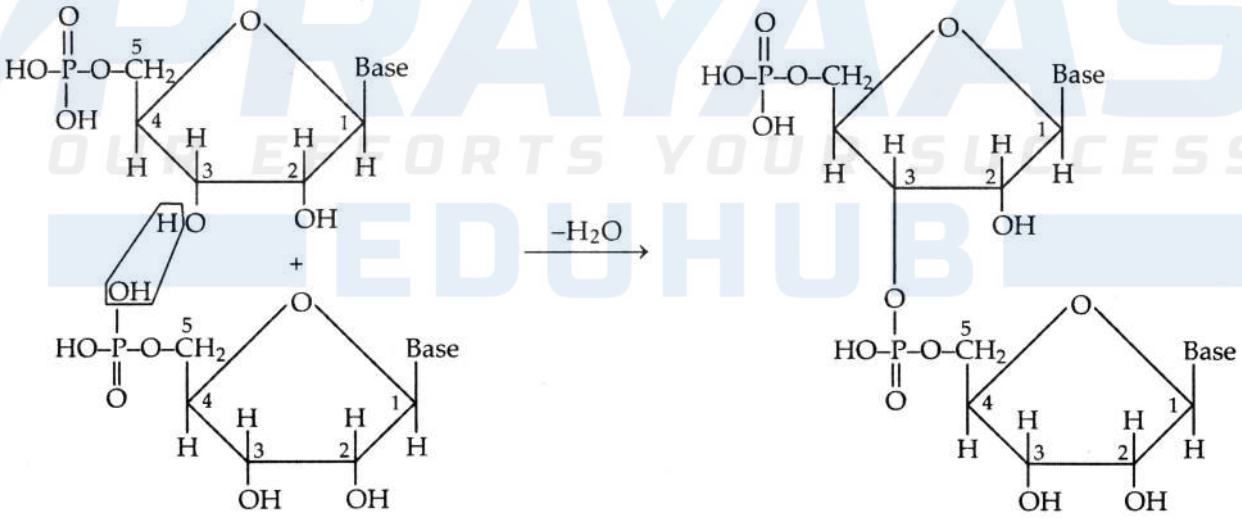


Nucleoside



Nucleotide

a) Primary structure of RNA : The two nucleotides are joined together by phosphodiester linkage between C–3 of one nucleotide and C–5 of another nucleotide to form dinucleotides.



Nucleotide Dinucleotides

When number of nucleotides are condense together to form very long chain of polynucleotide or RNA.

b) Secondary structure of RNA: The secondary structure of RNA are also present which are only single strand. Sometime they fold back themselves to form a double helix structure of RNA. RNA molecules are three types and they perform different functions these are named as

i) Messenger RNA (m–RNA)

ii) Ribosomal RNA (r–RNA)

iii) Transfer RNA (t–RNA)

Section–VI: Vitamins

Definition:

Organic substances required for regulating some body process are known as vitamins.

These compound can not be produced by organism. Vitamins are required in small amounts and deficiency of anyone vitamins causes diseases. Vitamins are denoted by alphabets A, B, C, D, E, K, H, P some of these are further named as B_1, B_2, B_3, B_5, B_6, B_{12}, etc.

Classification:

Depending upon solubility in water or oils,fats these are classified in three types,

1) **Water soluble:** B group and C group vitamins are water soluble. Water soluble vitamins supplied regularly in diet because they are readily exerted in urine and can not be stored in our body except vitamin B_{12}
2) **Fats soluble:** A, D, E, and K are insoluble in water and soluble in fats and oils. These are stored in liver and adipose tissue (fat storing tissues).
3) **Vitamin H (Biotin):** It is insoluble in water, fats and oils.

Classification:

Depending upon their chemical structure. These are classified as,

1) **Vitamins of aliphatic series:** They contain long chain of aliphatic compounds e.g. Vitamin–C
2) **Vitamins of aromatic series:** They contain long chain of aromatic compounds e.g. Vitamin–K
3) **Vitamins of alicyclic series:** They contain alicyclic ring e.g. Vitamin–A
4) **Vitamins of heterocyclic series :** They contain heterocyclic ring e.g. Vitamin–B (B_1, B_2, B_3, B_5, B_6, B_{12}), mesoinsositol, folic acid, vitamin –H.

Some vitamins, their sources and diseases due to deficiencies

No	Vitamins	Sources	Diseases due to deficiencies
1.	Vit–A Retinol/Axerophthol	Milk, fish liver,tomatoes, carrot, sweet potatoes	Night blindness, retardation of growth, dryness of skin and hair
2.	Vit–B_1 Thiamine	Rice, wheat, meat, green vegetable	Beriberi
3.	Vit–B_2 or G Riboflavin	Egg yolk, fishes, yeast, liver.	Inflammation of tongue, dryness of lips and mouth, cheilosis(retarding the growth and digestion
4.	Vit–B_3 Panthothermic acid	Yeast, liver, tomatoes, egg, meat,	Dermatitis, graying of hair, retard body and mental growth, reproductive deability
5.	Vit–B_5 Nicotinamide	Barely, liver, maize, wheat, rice	Pigmentation of skin (pellagra), degeneration of spinal cord, mental confusion.
6.	Vit–B_6 Pyriodoxine or pyridoxamine	Milk, liver,maize, wheat, fish, yeast	Convulsion, loss of weight, mental change, derangement of enzymes (which control carbohydrates metabolism)
7.	Vit–B_{12} Cyanocobalamin	Egg, liver of pig, sheep	Degradation of spinal cord, anaemia
8.	Vit–C Ascorbic acid	Orange, grapes, lemon, tomatoes, onion, cabbage	Scurvy(bleeding, spongy, swollen) gums
9.	Vit–D Ergocalciferol	Butter, liver, egg, fish oil, milk, meat, in skin cell in sun	Rickets, osteomalacia
10.	Vit–E Tocopherol	light Rice, liver of cattle, seed oils, wheat deposition	Weakness of muscles, abnormal growth and of tissue, decrease reproductive power
11.	Vit–H	Biotin Yeast, eggs, fruits, wheat	Skin lesions, loss of apatite, hair fall, paralysis
12.	Vit–K Phylloquinine	Green leafs of spinach, fish, meat, cauliflower	Increase blood clotting time (hemorrhage), poor coagulation of blood
13.	Vit–P	Orange, grapes	Haemorrhagia, decrease in capillary resistance

Section–VII: Hormones

14.7 Hormones:

These are chemical substances which are secreted by ductless gland and control different physiological function–of the body.

Hormones control growth of tissues, heart beat, blood pressure, secretion of digestive enzymes, kidney function, the reproductive system and lactation etc.

In mammals, the secretion of hormones is controlled by interior lobe of pituitary gland located at the base of brain. These hormones are then carried to other gland such as adernal cortex and sex gland to stimulate the production of other hormones.

Classification of hormones:

These are classified on the basis of structure and composition.

The are mainly classified in to three types:

1) Steroid hormones
2) Polypeptide hormones
3) Amino acid hormones

Sr.	Name of hormones	Sources/origin	Function
1)	**Steroid hormones**		
	Sex hormones		
	a) Androgens (Male sex hormon)		
	e.g. Testosterone	Testis	Regulate and stimulate male sex organs
	b) Female sex hormon		
	e.g. (i) estrogens	Overy	It maintain the function of female sex organs
	(ii) progesterone	Overy	It control the development and maintenance of pregnancy
2)	**Polypeptide hormones :**		
	i) Insulin	Pancreas	Maintain glucose level in blood, control carbohydrate metabolism by increasing glycogen in muscles and oxidation of glucose in tissue.
3)	**Amino acid hormones**		
	i) Thyroxine	Thyroid gland	Increase the rate of energy exchange and consumption of oxygen and also regulate metabolism of lipids, carbohydrates and proteins.
	ii) Adrenaline and non–adrenaline	Adernal medulla	They reinforce the function of symphatic nervous system like increase glucose level in blood and lactic acid in muscles.

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MULTIPLE CHOICE QUESTIONS

SECTION – I : CARBOHYDRATES

1. Choose the correct relationship for glucose and fructose
   a) these are functional isomers
   b) these are chain isomers
   c) these are position isomers
   d) all of these
2. Which one of the following compounds is different from the rest?
   a) Sucrose b) Maltose
   c) Lactose d) Glucose
3. Sugar which will not reduce Fehling's solution is
   a) maltose b) lactose
   c) sucrose d) glucose
4. An invert sugar is
   a) isorotatory b) dextrorotatory
   c) laevorotatory d) optically inactive
5. The open–chain glucose, (an aldohexose) and fructose (an 2–oxohexose) have .... and .... chiral carbons respectively
   a) 4, 4 b) 4, 3
   c) 3, 3 d) 3, 4
6. The total number of optical isomers in open–chain aldohexose (such as glucose) is
   a) 8 b) 8
   c) 16 d) 2
7. Ribose is an example of an
   a) aldopentose b) keto hexose
   c) aldohexose d) disaccharide
8. Digestible carbohydrate, which is also a constituent of our diet, is
   a) cellullose b) galactose
   c) maltose d) starch
9. Which of the following is a aldohexose?
   a) Fructose b) Sucrose
   c) Glucose d) Raffinose
10. Why? Chalk powder is added after complete hydrolysis of starch
    a) to solidify glucose b) to remove $CaSO_4$
    c) to neutralise H_2SO_4 d) to crystalise starch
11. Common table sugar is a disaccharide of
    a) glucose and fructose
    b) glucose and galactose
    c) fructose and galactose
    d) maltose and lactose
12. Which of the following carbohydrate is used in silvering of mirrors?
    a) Glucose b) Sucrose
    c) Cellulose d) Starch
13. The function of glucose is to
    a) provides energy b) promote growth
    c) prevent diseases d) perform all above
14. Which is the disaccharide present in the milk?
    a) Sucrose b) Maltose
    c) Galactose d) Lactose
15. Carbohydrates are stored in the body as
    a) sugars b) starch
    c) glucose d) glycogen
16. Sucrose hydrolyses readily in acids to give
    a) two molecules of glucose
    b) two molecules of fructose
    c) one molecules of glucose and fructose
    d) one molecules of glucose and galactose
17. Glucose is also known as
    a) grape sugar b) blood sugar
    c) dextrose d) all of these
18. Which of the following is polysaccharide?
    a) Glucose b) Ribose
    c) Sucrose d) Starch
19. All carbohydrates contain
    a) –CHO group b) >C = O group
    c) $–COO^-$ group d) $–CONH^-$ group
20. Which of the following statements concerning glucose is incorrect?
    a) It has 4 asymmetric C – atoms
    b) It is an aldehyde
    c) It is optically active
    d) It is a disaccharide
21. Starch is
    a) $C_{12}H_{22}O_{11}$ b) $C_6H_{10}O_5$
    c) $(C_6H_{10}O_5)_n$ d) $(C_6H_{12}O_6)_n$
22. On hydrolysis of starch by dilute acids we get finally
    a) glucose and fructose
    b) glucose
    c) fructose
    d) sucrose
23. A carbohydrates insoluble in water is

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

24. Which of the following monosaccharide is pentose?
a) Ribose b) Fructose
c) glycogene d) Glucose

25. Carbohydrates may be regarded as
a) aromatic compounds
b) alicyclic compounds
c) polyfunctional compounds
d) all of these

26. Glucose cannot be classified as
a) carbohydrate b) hexose
c) aldose d) olieosaccharide

27. The colour of precipitate formed when a reducing sugar is heated with Fehling's solution?
a) Yellow b) Red
c) Blue d) Green

28. Glucose is an example of
a) aldohexose b) ketohexose
c) disaccharide d) non–reducing sugar

29. Which of the following is not an essential constituent of carbohydrate?
a) N b) O
c) C d) H

30. Gum is
a) disaccharide b) monosaccharide
c) polysaccharide d) trisaccharide

31. Cane sugar is converted into a mixture of glucose and fructose by
a) aq. KOH b) H_3PO_4
c) ale. NaOH d) dil. HCl

32. A carbohydrate that cannot be hydrolysed into simpler units is called
a) polysaccharides b) trisaccharides
c) disaccharides d) monosaccharides

33. Hydrolysis of sucrose is called
a) saponification b) inversion
c) esterification d) hydration

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

35. Raffinose is an example of
a) trisaccharide b) disaccharide
c) monosaccharide d) polysaccharide

36. Which of the following is a animal polysaccharide?
a) Amylose b) Cellulose
c) Glycogen d) Pectin

37. Common sugar is
a) glucose b) fructose
c) sucrose d) both 'a' and 'b'

38. The intermediate compound in the conversion of starch to glucose is
a) maltose b) lactose
c) sucrose d) fructose

39. The carbohydrates which reduce Tollen's reagent and Fehling's solution are termed as
a) non–reducing sugars
b) reducing sugars
c) oxidised sugars
d) both 'b' and 'c'

40. Glucose and fructose are
a) optical isomers b) tautomers
c) metamers d) functional isomers

41. To become a carbohydrate, a compound must contain atleast
a) 3 carbons b) 6 carbons
c) 4 carbons d) 2 carbons

42. Which of the following is laevo rotatory?
a) Fructose b) Glucose
c) Sucrose d) All of these

43. A solution of d–glucose in water rotates the plane polarised light towards
a) right b) left
c) either side d) none of these

44. Aldotetroses consist of two different chiral carbon atoms and they exist in
a) 2 optically active forms
b) 4 optically active forms
c) 6 optically active forms
d) 8 optically active forms

45. Some statement are made below
1) glucose is aldohexose
2) naturally occurring glucose is dextro rotatory
3) glucose contain three chiral centre
4) glucose contain one 10 alcoholic group and four 20 alcoholic groups
Among the above correct statement(s) is/are
a) 1 and 2 b) 3 and 4
c) 1, 2 and 4 d) all are correct

46. The term invert sugar refers to an equimolar mixture of
a) glucose and galactose
b) glucose and fructose
c) glucose and mannose
d) glucose and ribose

47. Sugar present in fruits is
a) glucose b) galactose
c) fructose d) sucrose

48. Fructose contains
a) one ketonic group
b) two primary and three secondary alcoholic groups
c) five hydroxy groups
d) all of these

49. Glucose gives silver mirror test with Tollen's reagent. It shows the presence of
a) acidic group b) alcoholic group
c) aldehydic group d) ketonic group

50. Cellulose is a polymer of
a) galactose b) α –glucose
c) fructose d) β –glucose

51. Starch is a polymer of
a) α –glucose b) β –glucose
c) fructose d) mannose

52. The common source of carbohydrates, fats and proteins is
a) rice b) milk
c) egg d) ghee

53. 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) $C_{24}H_{42}O_{24}$

54. In the preparation of glucose from cane sugar, alcoholic medium is necessary to
a) get more yield of glucose
b) effect of separation of product
c) act as catalyst
d) to make reaction faster

55. Which one of the following is isomeric with sucrose?
a) Lactose b) Ribulose
c) Glucose d) Fructose

56. Some statements are given below
1. glucose is penta hydroxy aldehyde
2. fructose is ketohexose contain four chiral center
3. polymer of glucose is starch
4. fatty acids are aliphatic saturated higher monocarboxylic acids.
Among the above, correct statement(s) is / are
a) only 1 and 3 b) only 4
c) only 1, 3 and 4 d) only 1 and 4

57. Monosaccharides usually contains carbon atoms
a) C_3 to C_{10} b) C_1 to C_6
c) C_4 to C_{10} d) C_5 to C_8

58. All of the statements concering monoraccharides are correct except
a) the number of optical isomers is 2^n where 'n' is the number of asymmetric carbon atoms
b) monoraccharides with 5 to 6 carbons are carbohydrates
c) the monoraccharides with C_3 to C_{10} carbons are carbohydrates
d) sorbitol is not carbohydrates

59. Plants produces glucose by the process of
a) respiration b) autolysis
c) photosynthesis d) dialysis

60. Glucose is said to have CHO group. Which of the following reaction is not expected with glucose
a) it form oxime
b) it react with $NaHSO_3$
c) it reduce Tollen's reagent
d) form n–hexane with HI

61. Blood sugar and grape sugar are repectively
a) glucose, fructose b) fructose, glucose
c) glucose (of both) d) fructose (of both)

62. Consider the following statements about mono saccharides
1) they are optical active compound except dihydroxy acetone
2) fructose is ketose sugar but it is reducing sugar
3) glucose and fructose are functional isomers
4) fructose and glucose have same molecular formuls
Among the above correct statements is/are
a) 1 and 2 b) 2 and 3
c) 3 and 4 d) 1, 2, 3 and 4

63. Which is correct statement?
a) Starch is polymer of α –glucose
b) Amylose is component of cellulose
c) Protein are composed of only one type of α – amino acid
d) celloboise is polysaccharides

64. Sucrose on treatment with cone. HCl produces
a) glucose b) fructose
c) invert sugar d) gluconic acid

65. All monosaccharides are defined as
a) non reducing sugars
b) reducing sugars
c) hydrolysing sugars
d) non–hydrolysing sugars

66. When glucose react with bromine water the main product is
a) acetic acid b) saccharic acid
c) gluconic acid d) n–hexane

67. To detect reducing and non reducing sugar following test is used
a) Millon test b) Biuret test
c) Tollen's test d) Xanthoproteic test

68. The sugar that is disaccharide among the following is
a) glucose b) maltose
c) xlose d) stachyose

69. Glucose is reacted with HI gives
a) sorbitol b) n–hexane
c) saccharic acid d) gluconic acid

70. In the acetylation of glucose, which group is involved in the reaction
a) CHO group b) >C = O group
c) alcoholic OH group d) all of these

71. Glucose is oxidised by strong oxidising agent gives
a) saccharic acid b) gluconic acid
c) n–hexane d) sorbitol

72. Rhamnose has formula
a) $C_6H_{12}O_5$ b) $C_5H_{10}O_4$
c) $C_5H_{12}O_5$ d) $C_5H_9O_5$

73. Biomolecules are
a) aldehydes and ketones
b) acids and esters
c) carbohydrates, proteins and fats
d) alcohols and phenols

74. A glycogen is
a) a polysaccharide found in animals
b) a polysaccharide found in plants
c) a polysaccharide found in fruits
d) an enzyme

75. The carbohydrate which is found in cotton is
a) glycogen b) cellulose
c) sucrose d) starch

76. Chalk powder is added to hydrolysed solution of starch during the manufacture of glucose
a) for hydrolysis it is necessary
b) for cooling of sulphuric acid
c) for alkylation of sulphuric acid
d) because the hydrolysed solution of starch contains excess of sulphuric acid which as neutralised by chalk powder

77. Ethanolic hydrochloric acid is added in the preparation of glucose from sucrose because
a) hydrochloric acid provides acidic medium
b) glucose is insoluble in ethanol
c) fructose is soluble in ethanol
d) all of these

78. Gluconic acid is prepared by
a) oxidation of sucrose with bromine water
b) reduction of sucrose with sodium
c) reduction of glucose with sodium amalgam and water
d) oxidation of glucose by cone. HNO_3

79. Oxidation products of glucose are
a) sucrose b) glucaric acid
c) gluconic acid d) 'b' and 'c' both

80. Which one of the following is the reagent used to identify glucose?
a) Neutral ferric chloride
b) Chloroform and alcoholic KOH
c) Ammoniacal silver nitrate
d) Sodium ethoxide

81. On complete hydrolysis of starch, we finally get
a) Glucose
b) Fructose
c) Glucose and fructose
d) Sucrose

82. Sucrose on hydrolysis gives
a) Two molecules of glucose
b) Two molecules of fructose
c) One molecules each of glucose and fructose
d) One molecule each of glucose and mannose

83. Which one of the following compounds is found abundantly in nature?
a) Fructose b) Starch
c) Glucose d) Cellulose

84. Glucose is a
a) Monosaccharide b) Disaccharide

c) Trisaccharide d) Polysaccharide

85. The most common disaccharide has the molecular formula
a) $C_{10}H_{18}O_9$ b) $C_{10}H_{20}O_{10}$
c) $C_{18}H_{32}O_{11}$ d) $C_{12}H_{22}O_{11}$

86. Which one of the following give positive Fehling solution test?
a) Sucrose b) Glucose
c) Fats d) Protein

87. Sugars have the suffix
a) o1 b) ose
c) oside d) one

88. Carbohydrates have
a) bitter taste
b) sour test
c) sweet test
d) some have sweet test and some are tasteless

89. The carbohydrates which cannot be hydrolysed by human digestive system.
a) starch b) cellulose
c) glycogen d) glucose

90. Which carbohydrates is an essential constituent of plant cells
a) starch b) cellulose
c) sucrose d) glycogen

91. α – D(+) glucose and β – D(+) glucose are
a) an timers b) epimers
c) anomers d) tautomers

92. Glucose is heated with CH_3–OH in presence of dry HCl gas α –and β –methyl glucosides are formed.
This is because it contain
a) aldehyde group b) ketone group
c) CH_2–OH group d) a cyclic structure

93. The number of chiral carbon atoms present in cyclic structure α –D(+)) glucose
a) 3 b) 4
c) 5 d) 6

94. The reagent can be used to distinguish between cane sugar and lactose is
a) Bayer's reagent b) Iodine solution
c) Millon's reagent d) Tollen's reagent

95. Reaction of glucose with $(CH_3CO)_2O$ suggest that
a) pentahydroxy aldehyde
b) hydrate of carbon
c) pentahydroxy ketone
d) an hexahydric aldehyde

96. Maltose and glucose are
a) oxidising sugar
b) reducing sugar
c) first is oxidising and second is reducing sugar
d) both are non–reducing sugar

97. On heating glucose and Fehling's solution, use get precipitate whose colour is
a) yellow b) white
c) red d) pink

98. The disaccharides that gives only glucose on hydrolysis is
a) Lactose b) maltose
c) sucrose d) xylose

99. The letter D and L in carbohydrates represent
a) it's optical rotation b) its mutarotation
c) its direct synthesis d) its configuration

100. Sucrose is made up of
a) D–glucose + L–fructose
b) D–glucose + D–fructose
c) L–glucose + L–fructose
d) L–glucose + D–fructose

101. α –D– glucose and β –D– glucose differ from each other due to the difference in one of the carbon atom with respect to
a) configuration
b) number of OH–groups
c) conformation
d) size of hemiacetal ring

102. Which of the following is leavorotatory?
a) glucose b) sucrose
c) fructose d) lactose

103. An example of non–reducing sugar is
a) maltose b) lactose
c) cellobiose d) cane sugar

104. Cellulose is linear polymer of
a) α – (D) glucose b) β – (D) glucose
c) β – (D) fructose d) amylose

105. Which is correct statement
a) starch is polymer of α –glucose
b) Amylose is component of cellulose
c) In cyclic structure of fructose there are five carbons and one oxygen atom
d) glucose and galactose are anomers

106. Complete hydrolysis of cellulose gives
a) D–fructose b) D–glucose
c) D–ribose d) D–glucose

107. The two form of glucopyranose obtained from D–glucose are known as
a) epimers
b) anomers
c) enantiomers
d) geometrical isomers

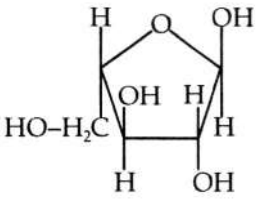
108. Glucose has different from fructose is that
a) does not undergoes hydrolysis
b) is a monosaccharides
c) gives silver mirror test with Tollen's reagent
d) none of the above

109. The term anomers of glucose refer to
a) isomer of glucose that differs in configuration at carbon one and four (C – 1 and C– 4)
b) a mixture of D–glucose and L–glucose
c) enantiomers of glucose
d) isomers of glucose that differ in configuration at carbon one (C–1)

110. Which of the following indicate open chain structure of glucose
a) penta–acetyl derivative of glucose
b) cyanohydrin formation with HCN
c) reaction with hydroxyl amine
d) reaction with Br_2 water

111. Which of the following does not form oxime?
a) glucose penta–acetate
b) glucose
c) xylose
d) galactose

112. Which of the terms correctly unidentified the carbohydrates shown.



1) Pentose 2) Hexose
3) Aldose 4) Ketose
5) Pyranose 6) Furanose
a) 2, 3, 4 b) 1, 3, 6
c) 1, 3, 5 d) 2, 4, 6

113. Cellulose is made up of
a) α –D–glucopyranose
b) α –D–glucofuranose
c) β –D–glucopyranose
d) β –D–glucofuranose

114. The monomer unit of starch are
a) α –glucose b) β –glucose
c) pyranose d) galactose

115. Maltose is made up of
a) α – D – glucose
b) D – fructose
c) α – D– glucose and β – D – glucose
d) glucose and fructose

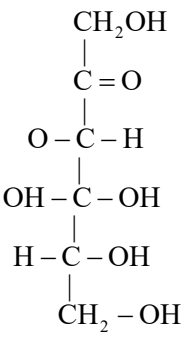
116. Reduction of glucose by HI suggest that
a) presence of OH groups
b) presence of –CHO group
c) cyclic structure of glucose
d) six carbon atoms are arranged in straight chain

117. Glucose is reduced by HI gives
a) sorbitol
b) glucitol
c) n–hexane
d) gluconic acid

118. Reaction of bromine water with glucose suggest that
a) 1° alcoholic group present in glucose
b) 2° alcoholic group present in glucose
c) aldehyde group present in glucose
d) cyclic structure of glucose

119. Oxidation of glucose by dil.HNO_3 gives saccharic acid. This reaction suggest that the presence of
a) aldehyde group
b) 1° – alcoholic group
c) 2° – alcoholic group
d) ketone group

120. Structure of D–fructose is

a)


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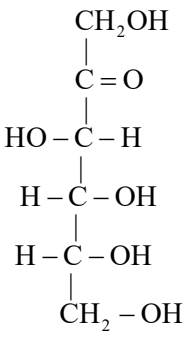
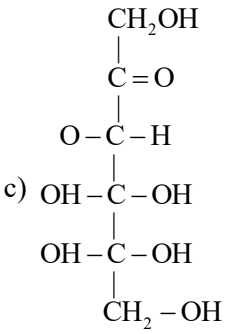
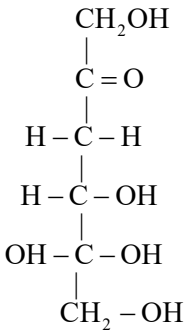
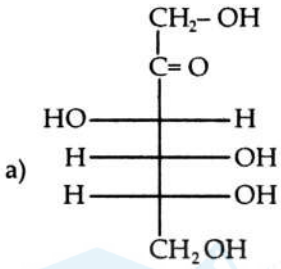
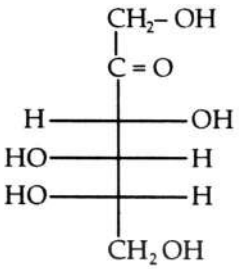


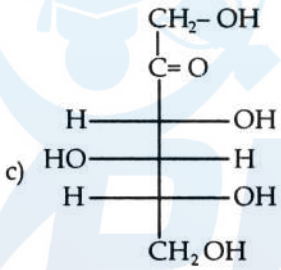
c) 

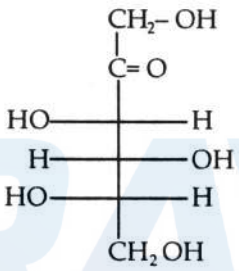
d) 

121. Which of the following is L–fructose?

a) 

b) 

c) 

d) 

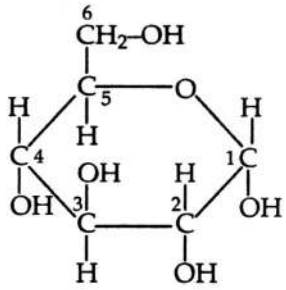
122. Glucose form hemiacetal between CHO group and –OH group on
a) C–2 b) C–3
c) C–4 d) C–5

123. Anomer of glucose is
a) six membered five carbon atoms and one oxygen atom cyclic structure
b) five membered five carbon atoms and one oxygen atom cyclic structure
c) six membered six carbon atoms and one oxygen atom cyclic structure
d) five membered four carbon atoms and one oxygen atom cyclic structure

124. Cyclic structure of D–glucose resembles with
a) furan b) pyran
c) THF d) oxiran

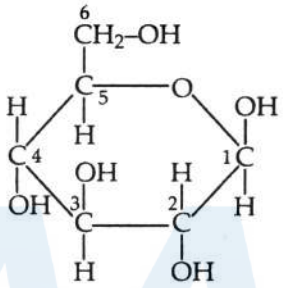
125. Aqueous solution of glucose on crystalline at 303k produces
a) anomers b) epimers
c) enantiomers d) polymers

126. Which sets of terms correctly identifies the carbohydrates shown



1) Pentose 2) Hexose
3) Aldose 4) Ketose
5) Pyranose 6) Furanose
a) 1, 3, 5 b) 2, 4, 5
c) 1, 3, 5 d) 2, 3, 5

127. The following cyclic structure represent



a) β – (D)–glucofuranose
b) β – (D)–glucopyranose
c) α – (D)–glucofuranose
d) α – (D)–glucopyranose

128. Isomerization of glucose produces
a) galactose b) fructose
c) mannose d) Allose

129. Fructose form hemiketal between >C = O group and –OH group of
a) C–3 b) C–4
c) C–5 d) C–6

130. Formation of hemiketal in fructose between > C = O group and OH group of C–5 atom, which carbon atom become chiral
a) C–1 b) C–2
c) C–3 d) C–4

131. α –(D)–(–)fructose and β –(D)–(–)–fructose are
a) anomers b) epimers
c) diastereoisomers d) tau tomers

132. In anomeric forms of fructose which carbon atom

involved in ring formation

a) C–2 and C–5 b) C–3 and C–5

c) C–2 and C–4 d) C–1 and C–5

133. α–(D)–(–) fructose and β–(D)–(–)–fructose differs in orientation at

a) C–1 b) C–2

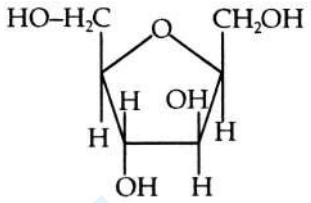
c) C–3 d) C–4

134. Cyclic structure of fructose resembles with

a) pyran b) furan

c) pyridine d) oxiran

135. Which set of terms correctly identifies the carbohydrate shown.



1) Pentose 2) Hexose

3) Aldoses 4) Ketoses

5) Pyranose 6) Furanose

a) 2, 3, 5 b) 1, 3, 5

c) 2, 4, 6 d) 1, 4, 6

136. Non reducing sugar end with suffix

a) oside b) ose

c) one d) al

137. Sucrose on hydrolysis produces equimolar mixture of

a) D(+)–glucose and D(+)– fructose

b) D(+)–glucose and D(–)– fructose

c) D(–)–glucose and L(+)– fructose

d) D(–)–glucose and L(–)– fructose

138. In disaccharide and poly saccharides two or more monosaccharides units are held together by

a) acetal bond b) glycosidic linkage

c) ether linkage d) all of these

139. Sucrose molecule is formed by monosaccharide of

a) α–D–glucofuranose and β–D–fructopyranose

b) α–D–glucopyranose and α–D–fructofuranose

c) α–D–glucopyranose and β–D–fructofuranose

d) β–D–glucopyranose and β–D–fructofuranose

140. Sucrose contain

a) 1–2 α–B – acetal bond

b) 1–2 α–α – acetal bond

c) 1–2 β–α – acetal bond

d) 1–2 β–β – acetal bond

141. In cyclic structure of cane sugar glycosidic bond is formed in between

a) C–1 of α – D–glucopyranose and C–5 of β–D–fructofuranose

b) C–5 of α – D–glucopyranose and C–1 of β – D–glucofuranose

c) C–1 of α – (D)–glucopyranose and C–2 of β–(D)–fructofuranose

d) C–2 of α – (D)–glucopyranose and C–1 of β–(D)–fructofuranose

142. Dextro rotatory sucrose is named equal as either

a) α – D–glucopyranosyl β–D–fructofuranoside

b) α–D–glucopyranoside β–D–fructofuranosyl

c) α – D–fructopyronoside

d) Both a and b

143. Maltose an hydrolysis produces

a) β–D–glucose b) α –D glucose

c) β–D–fructose d) α –D–fructose

144. In cyclic structure of maltose, acetal bond is formed between

a) C–2 of one glucopyranose and C–2 of another glucopyranose

b) C–1 of one glucopyranose and C–2 of another glucopyranose

c) C–1 of one glucopyranose and C–4 of another glucopyranose

d) C–1 of one glucopyranose and C–4 of fructofuranose

145. Maltose contain

a) 2–4–α –acetal bond

b) 1–2–α –acetal bond

c) 1–4–β acetal bond

d) 1–4–α acetal bond

146. Lactose on hydrolysis produces

a) β–D–glucose and β–D–galactose

b) α–D–glucose and α–D–galactose

c) α–D–glucose and β–D–galactose

d) β–D–glucose and α–D–galactose

147. In cyclic structure of maltose glycosidic linkage present between

a) C–1 of β –D–glucopyranose and C–2 of β –D–galactopyranose
b) C–4 of β –D–glucopyranose and C–1 of β –D–galactopyranose
c) C–1 of β –D–glucopyranose and C–4 of β –D–galactopyranose
d) C–4 of β –D–glucopyranose and C–1 of β –D–galactopyranose

148. Maltose contain
a) 1–4– β –glucoside bond
b) 2–4– α –glucoside bond
c) 1–3– β –glucoside bond
d) 2–3– β –glucoside bond

149. Cellobiose is obtained by
a) complete hydrolysis of cellulose
b) partial hydrolysis of cellulose
c) complete hydrolysis of glycogen
d) partial hydrolysis of raffinose

150. Cellobiose on hydrolysis produces
a) α –D–glucose b) α –D–fructose
c) β –D–glucose d) β –D–fructose

151. In cyclic structure of cellobiose acetal bond is formed between
a) C–1 of one β –D–glucopyranose and C–2 of another β –D–glucopyranose
b) C–1 of one β –D–glucopyranose and C–4 of another β –D– glucopyranose
c) C–1 of one β –D–glucopyranose and C–4 of another β –D fructofuranose
d) C–1 of one α –d–glucopyranose and C–4 of another β –D–glucopyranose

152. Cellobiose contain
a) C–1–C–4 glycosidic bond
b) C–1–C–3 glycosidic bond
c) C–2–C–4 glycosidic bond
d) C–3–C–4 glycosidic bond

153. Starch on hydrolysis produces
a) α –D–glucose b) β –D–glucose
c) α –D–fructose d) β –D–fructose

154. In starch molecule α –D–glucose molecule consist of
a) amylose and agar
b) amylopectin and agar
c) amylose and amylopectin
d) amylose and cellobiose

155. Amylopectin is
a) liner polymer of α –D–glucopyranose
b) branched polymer of α –D–glucopyranose
c) Linear polymer of β –D–glucopyranose
d) branched polymer of β –D–glucopyranose

156. In amylopectin glycosidic long chain and branching occurs in between
a) C–1 of one α –D–glucopyranose –C–4 of another α –D–glucopyranose and branching at C–1 of one glucopyranose C–6 of another glucopyranose
b) C–1 of one α –D–glucopyanose –C–3 of another α –D–glucopyranose and branching at C–1 of one glucopyranose and c–s of another glucopyranose
c) C–1 of one b–D–glucopyranose –C–4 of another b–D–glucopyranose and branching at C–1 of one P–D– glucopyranose and C–S of another β –D glucopyranose
d) C–2 of one α –D–glucopyranose –C–4 of another α –D–glucopyranose and branching at C–1 of α –D–glucopyranose and C–6 of another α –D–glucopyranose

157. In amylopectin glycosidic branching present in between
a) 1–4 α –D–glucopyranose
b) 1–4– β –D–glucopyranose
c) 1–6 α –D–glucopyranose
d) 1–6 β –D– glucopyranose

158. Amylose contain
a) C–1–C–4 β –D–glycosidic bond
b) C–1–C–4 α –D–glycosidic bond
c) C–1–C–6 β –D–glycosidic bond
d) C–1–C–4 β –D–glycosidic bond

159. Which of following has similar glycosidic bond
a) maltose and lactose
b) maltose and cellobiose
c) Amylose and amylopectin
d) maltose and amylose

160. Amylose and amylopectin are constituent of

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

161. Starch composed of
a) amylose and amylopectin
b) sucrose and maltose
c) maltose and lactose
d) amylose and celloboise

162. In cyclic structure of cellulose glycosidic bond present in between
a) C–1 of one β –D–glucopyranose and C–4 of another β –D–glucopyranose
b) C–1 of one β –D–glucopyranose and C–4 of another β –L–glucopyranose
c) C–1 of β –D–glucopyranose and C–4 of α –D–glucopyranose
d) C–1 of β –D–glucopyranose and C–4 of β –D–fructofuranose

163. Cellulose contain
a) C–1 → C–4 α –D glucopyranose glycosidic bond
b) C–1 → C–S α –D glucopyranose glycosidic bond
c) C–1 → C–4 β –D glucopyranose glycosidic bond
d) C–1 → C–4 β –D fructofuranose glycosidic bond

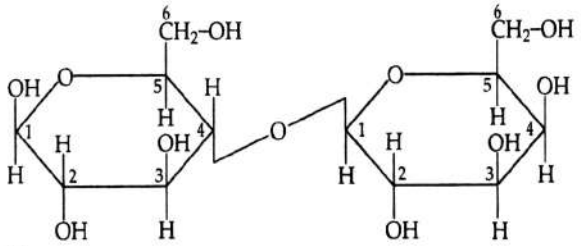
164. Glycogen is also known named as
a) Plant starch
b) animal starch
c) celloboise
d) Dextrin

165. Which of the following has highly branched of structure like amylopectin?
a) cellulose
b) maltose
c) fructose
d) glycogen

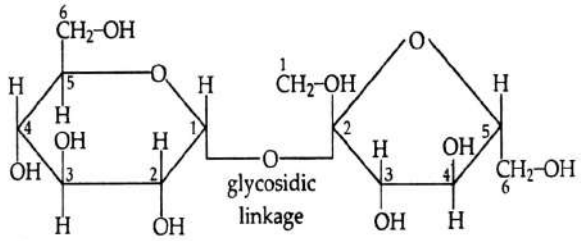
166. α –D–galactose and β –D– galactose are
a) epimers b) metamers
c) anomers d) tautomers

167. Which of following is maltose.

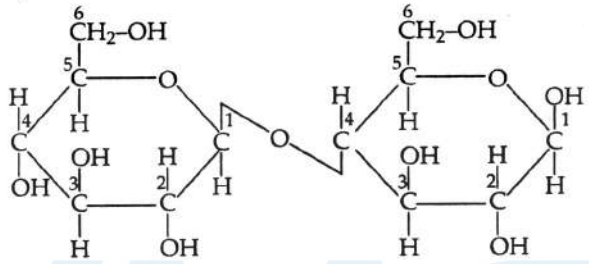
a)



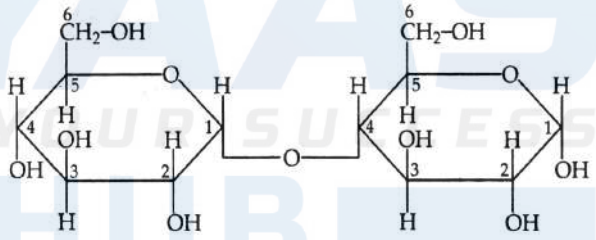
b)



c)



d)



168. How many chiral carbon atoms are present in ribulose?
a) 2 b) 3
c) 4 d) 5

169. A $\xrightarrow{H_3O^+}$ glucose + fructose

B $\xrightarrow{H_3O^+}$ glucose + galactose

C $\xrightarrow{H_3O^+}$ glucose + glucose

The A, B, C are respectively
a) sucrose, lactose, maltose
b) maltose, lactose, sucrose
c) sucrose, maltose, lactose
d) maltose, sucrose, lactose

170. Lactose can be names as
a) β –D–glucospyranosyl β –D–galactospyranose

b) α –D–glucospyranosyl α –D–galactospyranose
c) β –D–galactopyranosyl β –D–glucopyranose
d) α –D–galactopyranosyl α –D–glucopyranose

171. Hydrolysis of sucrose with dilute aqueous sulphuric acid yields
a) 1:10 (+)–Glucose; 0–(–)– fructose
b) 1:20 –(+)–Glucose; 0–(–)– fructose
c) 1:10 –(–)–Glucose; 0–(+)– fructose
d) 1:20 –(–) Glucose; 0–(+)– fructose

172. The number of chiral centres in the pyranose form of glucose is
a) 3 b) 4
c) 5 d) 6

173. Which of the following statement is / are correct?
I. Glucose is reducing sugar
II. Sucrose is reducing sugar
III. Maltose is non reducing sugar
IV. Lactose is reducing sugar
a) I and II only
b) I and III only
c) I and IV only
d) All

❍❍❍

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MULTIPLE CHOICE QUESTIONS

SECTION – II : PROTEINS

1. Amino acids are produced by the hydrolysis of
   a) fats b) proteins
   c) nucleic acids d) carbohydrates
2. Which among the following statements are true for glycine?
   1) It exists in crystalline form
   2) It is optically active
   3) It is soluble in water
   4) It can form Zwitter ions
   a) 1, 2, and 3 b) 1, 2, and 4
   c) 1, 3 and 4 d) 2, 3 and 4
3. Which among the following peptide linkage?
   a) $-C(=O)-NH-$ b) $-C(R)-O-N(H)-$
   c) $-C(R)=N-$ d) $-N=C(R)-O-$
4. Amino acids are the building block of
   a) fats b) vitamins
   c) proteins d) carbohydrates
5. An essential amino acid is one that
   a) must be included in the diet
   b) occurs in all types of protein
   c) contains no sulphur
   d) the body synthesis
6. The simplest amino acid is
   a) alanine b) valine
   c) tyrosine d) glycine
7. An amino acid with a phenolic hydroxyl group is
   a) alanine b) tyrosine
   c) valine d) phenyl glycine
8. Which of the following statements is not true?
   a) Protein is polypeptide
   b) Two peptides can form two different amino acids
   c) Peptides are not a–amino acids
   d) Peptides have amide linkage
9. Which one of the following is a protein?
   a) Rayon b) Nylon
   c) Natural silk d) Dacron
10. Which one of the following is not a protein?
    a) Wool b) Hair
    c) Cellulose d) Nail
11. A peptide bond joins two amino acids together. What atoms are linked by this bond in chain?
    a) C–O b) C–H
    c) C–N d) N–S
12. Which one of the following elements is not found in proteins?
    a) N b) F
    c) C d) O
13. Which one of the following is the general structural formula of an amino acid?
    a) RCH_2CONH_2 b) $RCH(NH_2)OH$
    c) RCH_2NH_2 d) $RCH(COOH)NH_2$
14. The functional group CONH found in protein is called as
    a) amide group b) carboxylic acid group
    c) peptide d) both 'a' and 'c'
15. Which of the following is a fibrous protein?
    a) Haemoglobin b) Keratin
    c) Albumin d) Enzymes
16. Which of the following is globular protein?
    a) Collagen b) Heamoglobin
    c) Myosin d) Fibroin
17. Magnesium is present in
    a) haemoglobin b) chlorophyll
    c) casein d) keratin
18. Iron present in haemoglobin is an
    a) ferrous state
    b) ferric state
    c) partly in ferrous and partly in ferric
    d) elemental state
19. Polymers of more than 10000 amino acids are termed
    a) proteins b) tripeptide
    c) dipeptide d) oligopeptide
20. Proteins are used as
    a) enzymes b) antivirus vaccines
    c) food d) all of these
21. Proteins are hydrolysed by enzymes into
    a) hydroxy acids b) α –amino acids
    c) dicarboxylic acid d) none of these
22. Proteins contain
    a) C, H, O b) only N

c) C, H d) C, H, O and N

23. Who proved that in proteins the amino acids are linked together by peptide linkage?
a) Emil Fisher b) Cannizzaro
c) Kekul d) Hoffman

24. Which of the following food stuffs contain nitrogen?
a) Glucose b) Fats
c) Proteins d) None of these

25. Insulin is a
a) hormone b) enzyme
c) carbohydrate d) fat

26. Keratin present in hair is,
a) Fibrous protein b) Globular protein
c) Denaturad protein d) Lipo protein

27. Which of the following molecules is capable of forming Zwitter ion?
a) NH_2CH_2COOH b) $CH_3CH_2NH_2$
c) CH_3CH_2COOH d) All of these

28. Which one of the following is an example of fibrous proteins?
a) Collagen in bone b) Myosin in muscles
c) Fibroin in silk d) All of these

29. Enzymes belong to
a) synthetic polymers b) polysaccharides
c) polypeptides d) polyesters

30. The protein that transports oxygen in the blood stream is
a) haemoglobin b) insulin
c) collagen d) albumin

31. Antibodies are
a) enzymes b) hormones
c) proteins d) amino acids

32. Polymer of α–amino acid is
a) acetamide b) ammonia
c) protein d) fatty acids

33. Some statements are given below
1. –CONH– linkage present in all proteins
2. proteins are addition polymer of α–amino acids
3. proteins are condensation polymer of α–amino acids
4. all polyamide are called proteins
Among the above, correct statement(s) is / are
a) only 1 b) only 3
c) only 1 and 4 d) only 1 and 3

34. Fabroin is term related to
a) hair b) milk
c) horn d) silk

35. The main structural feature of protein is
a) peptide linkage b) ester linkage
c) ether linkage d) all of these

36. Which of the following is structural protein?
a) Albumin b) Insulin
c) Thyroglobulin d) Albumin

37. Protein on hydrolysis gives
a) β–aminoacids b) α–aminoacids
c) γ–aminoacids d) o–aminoacids

38. The peptide bond joining amino acid into proteins is a specific example of
a) ester b) carbonyl
c) glycosidic d) amide

39. Two functional group that are present in all amino acids are the
a) hydroxy, amine b) hydroxy, amide
c) carboxyl, amino d) carboxyl, amide

40. Collagen is a example of
a) carbohydrates b) oils
c) fats d) proteins

41. Consider the following statements about proteins
1) All natural amino acids which constituents of proteins are L – amino acids
2) glycine is optically active
3) α – amino acids are connected by ester linkage
4) Myosin is structural protein
Among these statements
a) only 1 and 4 are correct
b) only 2 and 3 are correct
c) only 3 and 4 are correct
d) only 4 is correct

42. Simplest proteins has one peptide linkage. It is
a) tripeptide b) dipepetide
c) tetrapeptide d) oligopeptide

43. Consider the following compound
1) tyrocine 2) terephthalic acid
3) adipic acid 4) glucanic acid
which can form zwitter ion?
a) only 2 b) 1, 2, 3
c) only 1 d) 1, 2, 3, 4

44. Following acid can't not from a–amino acid
a) succinic acid b) tryptophane

c) phenyl alanine d) tyrosine

45. Peptides are amino acid polymer in which the individual amino acid units are called
a) monomer b) residue
c) epimer d) amide

46. A tripeptide has, how many peptide bond
a) 1 b) 2
c) 3 d) 4

47. Most of the amino acid have chiral centres but not in
a) phenyl alanine b) tryptophane
c) tyrocine d) glycine

48. Select correct statement
a) Valine is essential amino acid
b) in peptide linkage oxygen and hydrogen are at trans positions
c) molecular mass up to 10,000 are called polypeptide
d) all are correct

49. All of the following are example of fibrous proteins except
a) wool b) silk
c) horn d) insulin

50. The amino acids, which build up proteins, have both the COOH and NH_2 groups. These amino acids are
a) α –amino acids b) β –amino acids
c) γ –amino acids d) o–amino acids

51. Tyrosin contains
a) alcoholic OH group
b) phenolic OH group
c) aldehyde group
d) ketonic group

52. Thyroglobin is an example of
a) scieroproteins b) structural proteins
c) fibrous proteins d) globular proteins

53. Large molecules can be formed by the combination of a number of smaller molecules. These smaller molecules are called
a) isomers b) monomers
c) epimer d) polymers

54. Polypeptides are the chains of
a) amino acids b) nitrogen atoms
c) hydrogen atoms d) oxygen atoms

55. Which of the following statements about proteins is not true?
a) Amino acid residues join together to make a protein molecule
b) Proteins are polymers with formula $(C_6H_{10}O_5)_n$
c) Eggs are rich in protein
d) Pulses are good source of proteins

56. Which one of the following proteins transports oxygen in the blood stream ?
a) Myoglobin b) Insulin
c) Albugmin d) Haemoglobin

57. Mg is an important component of which biomolecule occurring extensively in living world?
a) Haemoglobin b) Chlorophyll
c) Vitamin d) ATP

58. Which is not true statement?
a) Protein is polymer of α –amino acids
b) All proteins are found in L–form
c) Human body can synthesize all proteins they need
d) At pH–7 both amino and carboxylic groups exist in ionised form

59. The functional group, which is found in amino acid, is
a) $-CH_3$ group b) $-NH_2$ group
c) –COOH group d) both 'b' and 'c'

60. Amino acids usually exist in the form of zwitter ions. This means that it consists of
a) no acidic or basic group
b) basic group – NH_3^+ and acidic group – CO_2
c) basic group – CO_2 and acidic group – NH_3^+
d) basic group – COO^- and acidic group – NH_3^+

61. Aqueous solution of α –amino acid is slightly acidic, which is due to
a) Acidic character of NH_3^+
b) basic character of COO^-
c) Acidic character of COO^-
d) basic character of NH_3^+

62. Which of the following have coiled helical structure
a) Lipids b) carbohydrates
c) vitamins d) proteins

63. Helical structure of protein is stabilized by
a) ionic bond
b) covalent bond
c) Vander Waals forces
d) hydrogen bond

64. Coagulation of protein is known as

a) dehydration b) decay
c) deamination d) denaturing

65. Point out wrong statement about protein
a) They are nitrogenous organic compound with high molecular weight
b) On hydrolysis by enzymes give α–L–amino acids
c) Many of them are enzymes
d) They do not contain polypeptide chain

66. The only α–amino acid which is achiral is
a) Lysin b) glycine
c) proline d) alanine

67. The number of amino acids which form proteins in nature is
a) 10 b) 15
c) 20 d) 30

68. Which one is not the essential constituent of balance diet
a) carbohydrates b) vitamins
c) fats d) hormones

69. The PH value of solution in which the polar amino acid does not migrate under the influence of electric field is called
a) neutralization point
b) isoelectronic point
c) isoelectric point
d) iso–merisation point

70. The human body does not produce
a) vitamins b) proteins
c) enzymes d) hormones

71. Point out wrong statement about proteins
a) These are polymeric macromolecules
b) They are present in food stuff
c) Many of them are hormones and enzymes
d) They do not contain CONH group

72. Fibrous protein are present in
a) wool b) haemoglobin
c) albumin d) thyroglobulin

73. Globular protein is present in
a) silk b) horn
c) keratin d) blood

74. Secondary structure of protein refer to
a) Three dimensional structure, specially the bond between amino acid residue that are distant from each other in the polypeptide chain
b) regular folding pattern of polypeptide chain
c) mainly denatured proteins and structure of prosthetic group
d) linear sequence of amino acid in polypeptide chain

75. One of essential α–amino acid is
a) Lysin b) serine
c) glycine d) proline

76. Which of the following biomolecule contain nontransition metal ion?
a) insulin b) chlorophyll
c) haemoglobin d) vitamin B–12

77. Which of the of following shows aromatic properties
a) valin b) serine
c) leucine d) tyrosine

78. The helical structure of protein is stabilized by
a) dipeptide bond
b) glycosidic bond
c) intramolecular hydrogen bond between–NH and carbonyl oxygen
d) Intermolecular hydrogen bond between –NH and carbonyl oxygen

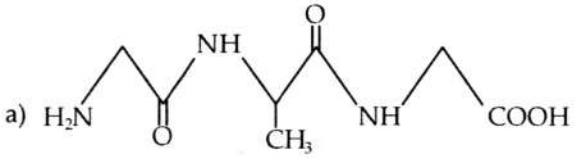
79. Which one of the bio–rnolecule is insoluble in water
a) keratin b) haemoglobin
c) insulin d) globulin

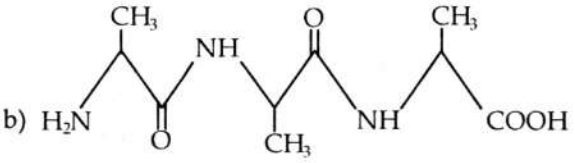
80. Which of the following exist as Zwitter ion?
a) salicylic acid b) sulphanilic acid
c) ethanamine d) p–aminoacetophenone

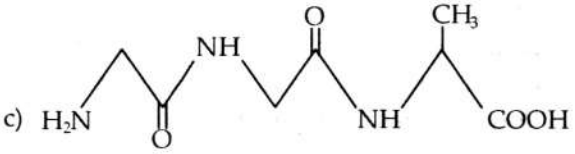
81. Which of the following is not globular protein?
a) keratin b) haemoglobin
c) insulin d) thyroglobulin

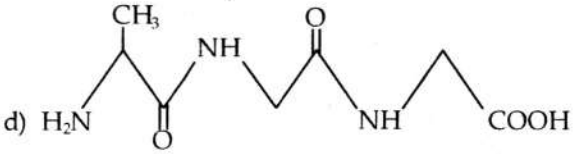
82. Which of the following statement about a–amino acid is not true?
a) They are present in all protein
b) Most naturally occurring amino acid have D–configuration
c) They are characterized by isoelectric point
d) Glycine is the only naturally occurring α–amine acid which is achiral

83. A tripeptide is written– glycine–alanine–glycine. The correct structure of tripeptide is

a) 

b) 

c) 

d) 

84. Denaturation of protein
a) disrupts the 1° and 2° structure of proteins
b) disrupts the 2° and 3° structure of proteins
c) disrupts 1°, 2°, 3° structure of proteins
d) is reversible process

85. Which of the following consist of only essential α–amino acids
a) glycine, serine, proline
b) valine, glycine, lucine
c) serine, Tryptophan, proline
d) valine, lucine, tryptophan

86. A nanopeptide contain how many peptide bond
a) 7 b) 9
c) 8 d) 10

87. An α–amino acid exist as $H_3\overset{+}{N} - CH_2 - COOH$ at PH(2) and its isoelectric point is 6. The amino acid at PH 10.97 will exist as
a) $H_3\overset{+}{N} - CH_2 - COOH^-$
b) $H_2N - CH_2 - COO^-$
c) $H_3\overset{+}{N} - CH_2 - COOH$
d) $H_2N - CH_2 - COOH$

88. Basic α–amino acids are
a) aspartic acid and histidine
b) arginine and histidine
c) lysin and histidine
d) serine and histidine

89. Match the list, and select correct answer from given codes

List I	List – II
1) Cheese like amino acid is	A) Glycine
2) Sulphur containing amino acid	B) Histidine
3) Basic amino acid	C) Cystine
4) Optically inactive amino acid	D) Tyrosine

a) 1 – A, 2 – B, 3 – C, 4 – D
b) 1 – D, 2 – B, 3 – A, 4 – C
c) 1 – B, 2 – D, 3 – A, 4 – C
d) 1 – D, 2 – C, 3 – B, 4 – A

90. The bond in protein structure, that are notbroken in denaturation is
a) hydrogen bond b) ionic bond
c) peptide bond d) sulphide bond

91. The amino acid which has a nonpolar side chain is
a) isoleusine b) aspartic acid
c) serine d) lysine

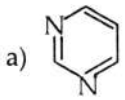
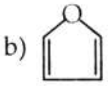
92. Non essential α–amino acid is
a) Alanine b) Valine
c) Leucine d) Lysine

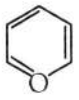
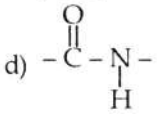
93. Proteins are polypeptide of
a) β–amino acid b) α–hydroxy acid
c) D–α–amino acid d) L–α–amino acid

94. Which of the following is a protein
a) serine b) glycogen
c) alanine d) keratin

95. Enzymes belong to which class of compound
a) polysaccharide
b) polypeptide
c) hydrocarbon
d) nitroheterocyclic compound

96. Which of the following structural unit found in enzymes or hormones

a)  b) 

c)  d) 

97. The acid showing salt like character in aqueous solution is
a) Acetic acid b) citric acid
c) proline d) fumaric acid

98. Which of following α–amino acid is achiral
a) Alanine b) proline
c) Valin d) glycine

99. Formation of cheese from milk is not

a) denaturation
b) breaking of hydrogen bond
c) breaking of ionic bond
d) breaking of peptide bond

100. Which of the following statement is true for proteins?
a) They act as antibodies
b) They act as hormones
c) They catalyze the biochemical reaction
d) all of these

101. Which bond is not present in a–helix structure of proteins
a) intermolecular hydrogen bond
b) intramolecular hydrogen bond
c) sulphide bond
d) Vander Waals forces

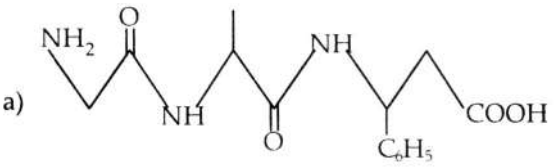
102. In β –pleated structure polypeptide chain is
a) α –helix b) β –helix
c) zig–zag d) linear

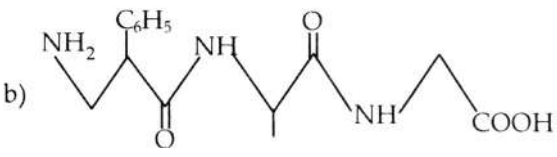
103. Which of the following has β –pleated structure
a) oxytocin b) mucin
c) fibroin of silk d) insulin

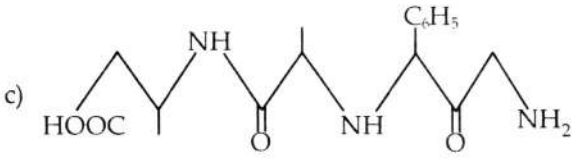
104. Tertiary structure of protein is arises due to
a) folding of polypeptide chain
b) folding, coiling and bonding of polypeptide chain
c) linear sequence of amino acid in polypeptide chain
d) denatured proteins

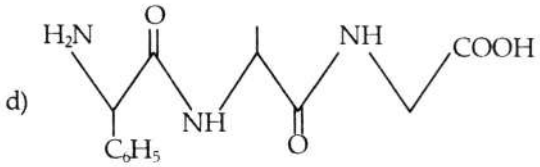
105. Linear sequence of polypeptide bond refer in
a) secondary structure
b) primary structure
c) tertiary structure
d) quaternary structure

106. A tripeptide is written phenyl alanine and glycine. The correct structure of tripeptide is

a) 

b) 

c) 

d) 

107. Which of the following provide chief structural material for tissues
a) myosin b) insulin
c) albumin d) pepsin

108. During coagulation of egg which change occurs
1) breaking of peptide bond
2) breaking of hydrogen bond
3) breaking of ionic bond
4) breaking of sulphide bond
a) only 1 b) 1,2,4
c) 2,3,4 d) 1,2,3,4

109. Curdling of milk is
a) naturation of protein
b) denaturation of protein
c) folding of polypeptide chain
d) coiling of polypeptide chain

110. Tertiary structure of protein is stabilized by
1) hydrogen bond
2) ionic bond
3) sulphide bond
4) Vander Waals force
a) 2, 4 b) 1, 2
c) 1, 2, 4 d) 1, 2, 3, 4

111. The P_H – 5, glycine exist as
a) $H_3N^+ - CH_2 - COO^-$
b) $H_3N^+ - CH_2 - COOH$
c) $H_2N - CH_2 - COO^-$
d) $H_2N - CH_2 - COOH$

112. The PH –7 alanine exist as

a) $H_3N^+ - \underset{\displaystyle CH_3}{\underset{|}{CH}} - COO^-$

b) $H_3N^+ - \underset{\displaystyle CH_3}{\underset{|}{CH}} - COOH$

c) $H_2N-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COO^-$

d) $H_2N-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$

113. At PH–9, alanine exist as

a) $H_3N^+-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COO^-$

b) $H_3N^+-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$

c) $H_2N-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COO^-$

d) $H_2N-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$

114. Which of the following is not protein?

a) wool b) hair

c) nail d) starch

❍❍❍

MULTIPLE CHOICE QUESTIONS

SECTION – III : LIPIDS

1. The group linkage present in fats is
   a) peptide linkage b) ester linkage
   c) glycosidic linkage d) none of these
2. A distinctive and characteristic functional group of fats is
   a) an ester group b) a peptide group
   c) a ketonic group d) an alcoholic group
3. The alcohol obtained by the hydrolysis of oils and fats is
   a) glycol b) glycerol
   c) propanol d) pentanol
4. Most concentrated source of energy in human body is
   a) nucleic acid b) sugars
   c) fats d) proteins
5. Lipids are
   a) amino acids
   b) carbohydrates
   c) enzymes
   d) esters of long chain fatty acids and alcohols
6. Oils and fats are esters of higher fatty acids with
   a) glycerol b) glycol
   c) alcohol d) ethers
7. Fats and oils are
   a) aldehydes b) esters
   c) acids d) alcohols
8. Glycerol tristearate (stearin) can not undergo, which of the following reaction?
   a) Saponification b) Acid hydrolysis
   c) Hydrogenation d) None of these
9. The most important reserves food of animals are
   a) carbohydrates b) proteins
   c) vitamins d) fats
10. Vegetable oils are
    a) glycerides of unsaturated fatty acids
    b) glycerides of saturated fatty acids
    c) sodium salts of higher fatty acids
    d) mixture of sodium and potassium salts of lower acids
11. The function of fat in the body is to act as
    a) thermal insulator
    b) an absorber of minerals
    c) catalyst
    d) enzyme
12. Which of the following is an ester?
    a) Soap b) Seed oil
    c) Glycerine d) Kerosene oil
13. Which of the following reaction takes place during the preparation of triglyceride?
    a) If–atom from –OH group of glycerol is replaced by acetyl group
    b) H–atom from –OH group of glycerol is replaced by acyl group
    c) –OH–group of glycerol and H–atom of from carboxylic group of the acid are eliminated as H_2O molecule.
    d) H–atom from –OH group of glycerol is replaced by alkyl group
14. Fats and oils are formed from respectively.
    a) glycerol and long chain unsaturated acids only
    b) glycerol and long chain saturated acids only
    c) glycerol and long chain saturated acids and unsaturated acids
    d) ethylene glycol and long chain unsaturated and saturated acids
15. The molecular formula of saturated fatty acid is
    a) $C_nH_{2n}O_2$ b) $C_nH_{2n-1}O_2$
    c) $C_nH_{2n+2}O_2$ d) $C_nH_{2n+1}O_2$
16. Fats contain higher percentage of
    a) unsaturated fatty acids
    b) saturated fatty acids
    c) free fatty acids
    d) glycerol
17. Which of the following are lipids?
    a) Only oils b) Only fats
    c) Oils and fats d) Sugars
18. Oils are
    a) triglycerides of saturated fatty acids
    b) triglycerides of unsaturated fatty acids
    c) diglycerides of saturated fatty acids
    d) diglycerides of unsaturated fatty acids
19. Glycerides are
    a) esters of fatty acids and glycol
    b) esters of fatty acids and glycerol
    c) esters of fatty acids and sorbitol
    d) esters of fatty acids and glucose
20. Which of the following compound does not

belongs to liquids?
a) Fats b) Ethanol
c) Ethanoic acid d) Oils

21. Some statements are given below about oils and fats
1. oils can be converted into fats and vice versa
2. oils and fats are triesters
3. oils have high melting point than fats
4. fats have strong Vander Waals force of attraction than oils,
Among the above, correct statement(s) is / are
a) only 2 b) only 4
c) only 2 and 4 d) only 1

22. Monoterpene contain how many carbon atoms?
a) 10 b) 12
c) 14 d) 16

23. The characteristic functional group of fats is
a) an ester group b) ether
c) a peptide group d) an alcoholic group

24. A glyceride is
a) an ether formed by glycerol
b) an ester of glycerol with fatty acids
c) a molecular compound of glycerol with a metal salt
d) none of these

25. Which alcohol reacts with fatty acids to form fats?
a) Ethanol b) Glycerol
c) Methanol d) Isopropanol

26. Which is not essential constituent of diet?
a) Soap b) Glucose
c) Carbohydrate d) Protein

27. Main elements present in lipids are
a) C b) H
c) O d) C, H, O

28. Which of the following is lipids
a) fats b) glycogen
c) blood d) pepsin

29. Lipids serves
a) biocatalyst b) transport oxygen
c) provide energy d) provide immunity

30. Complex lipids contains
a) phosphoric acid
b) phosphorous acid
c) hyphophosphoric acid
d) metaphosphoric acid

31. Which of the following is phospholipids?
a) vitamin A b) prostaglandians
c) Lecithin d) vitamin O

32. In phospholipids
a) two –OH group of glycerol are esterified
b) One OH group of glycerol is esterified
c) Three OH groups of glycerol are esterified
d) No any OH group of glycerol is esterified

33. In plant glycolipids sugar is
a) glucose b) fructose
c) galactose d) mannose

34. The typical animal glycolipids is
a) lecithin b) cephalin
c) prostaglandins d) cerebrosides

35. Waxes are
a) ester of long chain carboxylic acids and long chain monohydric alcohols
b) polypeptides of long chain nitrogen base
c) long chain fatty acid
d) esters of long chain aldehydes and ketones

36. Steroids are derived from
a) highly branched glycerides
b) long chain fatty acids
c) cyclopenta perhydrophenanthrene
d) galacto cerebrosides

37. Which of the following is simple lipids?
a) Fat soluble vitamins
b) prostaglandins
c) anomer of D–glucose
d) both a and b

38. Which of the following do not contain ester linkage
a) lecithin b) oils
c) fats d) cholesterol

39. Testosterone is
a) animal steroid
b) plant steroid
c) ester of long chain fatty acid
d) triolein

40. Terpenes are
a) four ring cyclic structure
b) unsaturated hydrocarbon
c) fatty acids
d) containing heterocyclic ring

41. Which of the following is plant steroid?
a) estrogen b) testosterone
c) androsterone d) sitosterol

42. Ergosterol is
a) animal sterol b) fungal sterol
c) terpenes d) simple lipids

43. β –carotin is
a) monoterpene b) sequiterpene
c) diterpene d) tetra terpene

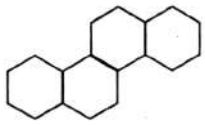
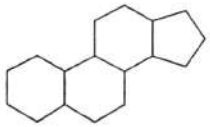
44. Prostaglandins is
a) a group of C_{20} lipids
b) a group of C_{10} lipids
c) a group of C_{50} lipids
d) a group of $C_{10}D$ lipids

45. Which of the following is detected in body tissues
a) testosterone b) estrogen
c) sitosterol d) prostaglandins

46. Abscisic acid is
a) triglyceride of long chain alcohol
b) sesquiterpenes
c) diterpenes
d) glycoli pids

47. Fat soluble vitamins are
a) Proteins b) Complex lipids
c) Simple lipids d) Carbohydrates

48. Which of the following is steroid nucleus

a) 
b) 
c) 
d) 

49. Isoprene unit present in
a) terpenes b) waxes
c) phospholipids d) glycolipids

50. Phytol is
a) oils b) fats
c) terpenes d) glycolipids

51. The glycolipids abundantly found in
a) oils
b) fats
c) keratin in hair
d) myelin sheath of neurons

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SECTION – IV : ENZYMES

1. Which catalyzed biological reaction.
   a) hormones b) enzymes
   c) glycogen d) fats
2. Enzymes are
   a) carbohydrates b) lipids
   c) fats d) polypeptides
3. The function of enzymes in living system is to
   a) transport oxygen
   b) provide immunity
   c) catalyze biochemical reaction
   d) provide energy
4. Which of the following statement about enzymes is / are true
   1) enzymes lacks in nucleophilic group
   2) enzymes are highly specific and selective
   3) Enzyme catalyze the chemical reaction by lowering the activation energy
   4) pepsin is enzymes
   a) 2, 3, 4 b) 1, 4
   c) 2, 3 d) 1, 2, 3, 4
5. Which of the following is not correct for enzymes
   a) It acts as biocatalyst
   b) It can catalyze any chemical reaction
   c) It increase rate reaction by lowering activation energy
   d) Maltose convert glucose by using maltase enzyme
6. Enzymes are made up of
   a) carbohydrates
   b) nitrogen containing carbohydrates
   c) edible proteins
   d) protein with specific structure
7. The effect of enzymes on a biological reaction is that the
   a) rate of forward reaction is increased but the rate of backward reaction is not altered
   b) rate of backward reaction is decreased but rate of forward reaction is not altered.
   c) rate of forward reaction and backward reaction are altered by the same factor so that
   d) neither rate of forward reaction nor that of backward reaction is altered

SECTION – V : NICLEIC ACID

1. Chromosomes are made from
   a) proteins
   b) nucleic acids
   c) proteins and nucleic acids
   d) carbohydrates and nucleic acids
2. The relation between the nucleotide triplets and the amino acid is called
   a) enzymes b) replication
   c) genetic code d) mutation
3. Bases common to RNA and DNA are
   a) adenine, guanine, cytosine
   b) adenine, uracil, cytosine
   c) adenine, guanine, thymine
   d) guanine, uracil, thymine
4. In nucleotide phosphate group is attached to
   a) C – 1 b) C – 2
   c) C – 4 d) C – 5
5. In nucleoside adenine is attached to
   a) C – 2 b) C – 1
   c) C – 3 d) C – 4
6. In nucleic acid the sequence is
   a) base–phosphate–sugar
   b) base–sugar–phosphate
   c) sugar–base–phosphate
   d) phosphate–base–sugar
7. A base–sugar–phosphate unit in nucleic acid is called as
   a) base phosphate b) nucleotide
   c) phosphotide d) nucleoside
8. Nucleic acids are
   a) polymer of nucleoside
   b) polymer of purine base
   c) polymer of nucleotides
   d) polymer of pyrimidine base
9. The function of DNA is
   a) to synthesis RNA
   b) to synthesis necessary proteins
   c) to carry the hereditary character
   d) all are correct
10. RNA is
    a) single helix strand b) double helix strand
    c) triple helix strand d) all of these
11. Which of the following is responsible for the heredity character of cell
    a) RNA b) DNA
    c) proteins d) hormones
12. The reason for helical structure of DNA is operation of
    a) hydrogen bond

b) electrostatic attraction
c) Vander Waals forces
d) dipole–dipole attraction

13. The purine base present in RNA is
a) adenine b) cytosine
c) uracil d) thymine

14. Nucleoside on hydrolysis gives
a) an aldopentose and heterocyclic base
b) an aldopentose and orthophosphoric acid
c) an aldopentose, heterocyclic base and or tho phosphoric acid
d) heterocyclic base and orthophosphoric acid

15. Which of the following statement is true for protein synthesis (translation)
a) Amino acids are directly recognize by m–RNA
b) The third base of codon is less specific
c) Only one codon codes for an amino acids
d) every t–RNA molecule has more than one amino acid attachment

16. DNA multiplication is called as
a) translation b) transduction
c) transcription d) replication

17. Pyrimidine base present in DNA are
a) Adenine and cytosine
b) Guanine and thymine
c) cytosin and thymine
d) Adenine and guanine

18. Thymine is
a) 1 – methyl uracil b) 3 – methyl uracil
c) 4 – methyl uracil d) 5 – methyl uracil

19. RNA differ from DNA in respect to base
a) Thymine b) Cytosine
c) Adenine d) Guanine

20. DNA differ from RNA in respect to base
a) uracil b) cytosine
c) adenine d) guanine

21. RNA and DNA are chiral molecule, their chirality is due to
a) chiral phosphate ester linkage
b) D – sugar component
c) L – sugar component
d) chiral base

22. A sequence of how many nucleotides in messenger RNA makes a codon for an amino acid?
a) 2 b) 3
c) 4 d) 5

23. In DNA complimentary bases are
a) Adenine and guanine, thymine and cytosine
b) Adenine and thymine, cytosine and guanine
c) Adenine and cytosine, guanine and thymine
d) Thymine and uracil, cytosine and guanine

24. Which of the following is not present in nucleotide?
a) cytosine b) adenine
c) guanine d) tyrosine

25. Which of the following is not present in nucleoside?
a) phosphoric acid b) cytosine
c) uracil d) guanine

26. Consider the double helix structure of DNA. The base pair are
a) part of the back bone structure
b) in side the helix
c) out side the helix
d) all of these

27. Mutation in DNA occurs due to change in the sequence of
a) nitrogen base b) ribose unit
c) phosphate unit d) all of these

28. DNA consist of
a) β – D – ribose sugar
b) β –D deoxyribose sugar
c) α –D ribose sugar
d) α –0 – deoxyribose sugar

29. Polynucleotide chain is
a) polyamide chain b) polyester chain
c) polypeptide chain d) polyglycosidic chain.

30. Uracil pyrimidine base is present in
a) DNA b) RNA
c) β –D – ribose d) β –D – deoxyribose

31. In nucleoside base unit is attached at
a) position one of pentose sugar unit
b) position two of pentose sugar unit
c) position three of pentose sugar unit
d) position of four of pentose sug~r unit

32. Nucleoside consist of
a) sugar and H_3PO_4
b) sugar and base
c) H_3PO_4 and base
d) only pentose sugar unit

33. In nucleotide phosphonic acid link at position.
a) one of pentose sugar

b) one of base unit
c) five of pentose sugar
d) five of base unit

34. The linkage present in two nucleotide is
a) amide linkage
b) peptide linkage
c) phosphodiester linkage
d) glycosidic linkage

35. Phospho diester linkage present between
a) 1 and 2 carbon atoms of two pentose sugar
b) 3 and 5 carbon atoms of two pentose sugar
c) 2 and 3 carbon atoms of two pentose sugar
d) 1 and 3 carbon atoms of two pentose sugar

36. Pentose sugar present in RNA is
a) β – D – ribose
b) α – D – ribose
c) β – D –2– deoxyribose
d) α – D – deoxyribose

37. β – D – 2 – deoxyribose means
a) no H – atom at C – 2 position
b) no OH – group at C – 2 position
c) no – H – atom at C – 3 position
d) no – OH – group at C–3 position

SECTION – VI : VITAMINS

1. Which biomolecule doesn't produce in human
a) protein b) glycogen
c) testosterone d) vitamins

2. Which of the following are water soluble vitamins
1) vit–B, 2) vit–C
3) vit–E 4) vit–D
a) 1, 3 b) 1, 2
c) 3, 4 d) 1, 4

3. Which of the following are fats soluble vitamins?
1) vit–A 2) vit–D
3) vit–H 4) vit–K
5) vit–C
a) 1, 2, 4 b) 2, 4, 5
c) 3, 4, 5 d) 1, 2, 3, 4

4. The vitamin which contain aromatic ring is
a) vitarnin–K b) Vitamin–C
c) vitamin–A d) vitamins–B

5. Vitamin–C is
a) aliphatic vitamin b) aromatic vitamin
c) alicyclic vitamin d) heterocyclic vitamin

6. Structural unit of vit–B is
a)  b) 
c)  d) $-CH_2-CH_2-CH_2-$

7. Structural unit of vitamin–A is
a)  b) 
c)  d) $-CH_2-CH_2-CH_2-$

8. The vitamins stored in body is
a) vit–C b) vit–B_1
c) vit–B_1 d) vit–D

9. Vitamin – C is
a) citric acid b) ascorbic acid
c) lactic acid d) tartaric acid

10. Ascorbic acid is
a) protein b) vitamin
c) enzyme d) oil

11. Chemical name of vitamin–A is
a) thiamine b) axerophthol (retinol)
c) thiamine d) nicotinamide

12. Vitamin that is most readily produced in our body is
a) vit–C b) vit–B
c) vit–D d) vit–P

13. Vitamin A deficiency leads to disease known as
a) beri–beri b) T.B.
c) Join pain d) night blindness

14. Which of the following is found in cod–liver oil?
a) vit–A b) vit–C
c) vit–E d) vit–B_1

15. Deficiency of vit–E causes
a) scurvy b) beri–beri
c) antifertility d) TB

16. Vit–B_2 is also known as
a) Tocopherols b) Retinol
c) riboflavin d) pyridoxine

17. Vit–B_1 is known as
a) Retinol b) thiamine
c) riboflavin d) ascorbic acid

18. The vitamin which is water soluble and antioxidant
a) vit–A b) vit–B
c) vit–C d) vit–D

19. Rickets is caused due to the deficiency of
a) vit–A b) vit–B
c) vit–C d) vit–D

20. Vitarnin–D is also known as
a) ascorbic acid b) reproductive vitamin
c) growth vitamin d) sunshine vitamin

21. Identify the vitamin whose deficiency out food decrease reproductive power
a) vit–A b) vit–D
c) vit–E d) vit–P

22. Which of the following is provitamin –A
a) citric acid b) riboflavin
c) β –carotene d) calciferol

23. Vitamin– D is
a) tocopherol b) ergosterol
c) tocopherols d) calciferols

24. Beri–beri is caused due to
a) vit–A b) vit–C
c) vit–B d) vit–D

25. Scurvy is caused due to
a) vit–A b) vit–K
c) vit–E d) vit–C

26. Vitamin which play role in coagulation property of blood is
a) vit–A b) vit–K
c) vit–E d) vit–D

27. Two vitamins absorbed from intestine along with fats are
a) A and D b) A and C
c) A and B d) D and C

28. Lack of vit–P causes
a) Beri–beri b) weakness of muscles
c) Hemorrhage d) Scurvy

29. Biotin is an organic compound present in yeast. It's deficiency in diet causes paralysis. It is also known as
a) vit–A b) vit–B_3
c) vit–B_{12} d) vit–H

30. The vitamin which is neither soluble in water nor in fats is
a) vit–A b) vit–H
c) vit–P d) vit–D

31. Convulsions is caused due to deficiency of
a) vit–B b) vit–P
c) vit–H d) vit–D

32. The vitamin present in liver of pig in
a) B_2 b) B_3
c) B_6 d) B_{12}

33. Nicotinamide is named for
a) vit–B_2 b) vit–B_5
c) vit–B d) vit – B_{12}

34. Cyanocobalamin is
a) vit–A b) vit–B
c) vit–B_1 d) vit–B_{12}

35. Deficiency of poor coagulation of blood is due to lack of
a) vit–A b) vit–C
c) vit–E d) vit–K

SECTION – VII : HORMONES

1. The hormones which controls the presence of burning of fats, proteins, and carbohydrate and liberates energy in the body is
a) thyroxine b) insulin
c) adrenaline d) cortisone

2. Which of the following is not sex hormones?
a) Testosterone b) Estrogen
c) Progesteron d) Thyroxin

3. Insulin is secreted from
a) thyroid b) adrenal body
c) pancreas d) liver

4. The hormone which transport glucose form blood to tissue is
a) glycogen b) thyroxin
c) insulin d) heparin

5. Hormones which regulate metabolism of lipids, carbohydrates and protein is
a) epinephrine b) thyroxin
c) oxytocin d) estrone

6. Insulin regulate the metabolism of
a) minerals b) amino acids
c) glucose d) vitamins

7. Hormones that help in the conversion of glucose to glycogen is
a) cortisone b) adrenaline
c) bile acid d) insulin

8. Which of the following is female sex hormones?
a) Adrenaline b) Non–adrenaline
c) Estrogen d) Testosterone

9. Hormones are secreted from
a) plant cell wall b) nerve tissues
c) duct less gland d) heart

10. Which control the secretion of all hormones
a) kidney b) liver

c) heart d) pituitary gland

11. Hormones are
a) steroid b) peptide
c) amino acid d) all of these

12. Which amine hormone control function of sympathetic nervous system?
a) thyroxin b) progestron
c) Adrenaline d) insulin

13. Hormones which control the development and maintenance of pregnancy is
a) estrone b) cortisone
c) progesterone d) vasopressin

14. Which hormones increase lactic acid in muscles?
a) progestron b) estrogene
c) nor–adrenaline d) androgen

15. Which of the following is polypeptide hormones?
a) gestogens b) insulin
c) nor–adrenaline d) progestron

16. Which of following is/are steroid hormones?
a) testosterone b) progestogen
c) estrogene d) all of these

17. Which of the following is protein hormones
a) insulin b) testosteron
c) thyroxin d) progestron

18. Which of the following are amino acid hormones
1) thyroxin 2) Adrenaline
3) insulin 4) estrogen
a) 1, 3 b) 1, 2
c) 2, 3 d) Only 1

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