BIOMOLECULES

4 MARKS

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CARBOHYDRATES

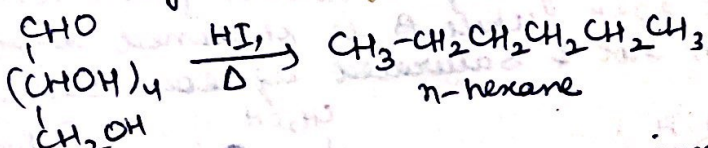
MONOSACCHARIDES: A carbohydrate that can not be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone is called monosaccaride. eg: Glucose, fructose

OLIGOSACCHARIDES: That on hydrolysis gives 2-10 units of monosaccarides eg: sucrose, maltose

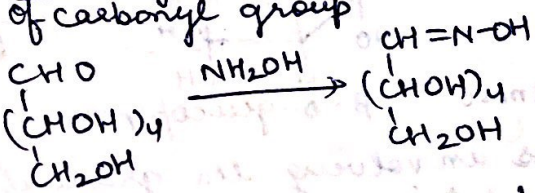
POLYSACCARIDE: That on hydrolysis gives large number of monosaccaride units eg: starch, cellulose

IMPORTANT REACTIONS OF GLUCOSE

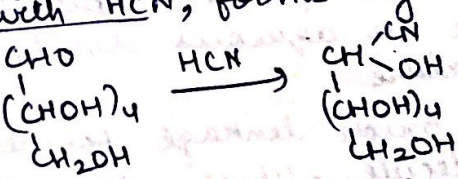
1. on prolonged heating with HI, it forms n-hexane, suggesting that all the six C-atoms are linked in a straight chain.



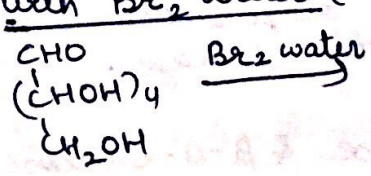
2. with hydroxylamine forms oxime; confirm the +nce of carbonyl group



3. with HCN, forms cyanohydrin

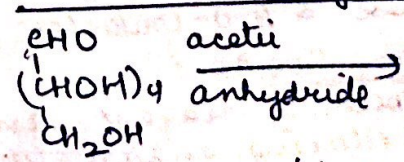


4. with Br_2 water (mild oxidising agent)

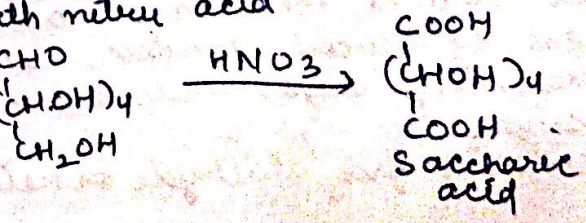


carbonyl grp is aldehyde.

5. with acetic anhydride gives glucose pentaacetate confirms five -OH groups.



6. with nitric acid



Saccharic acid

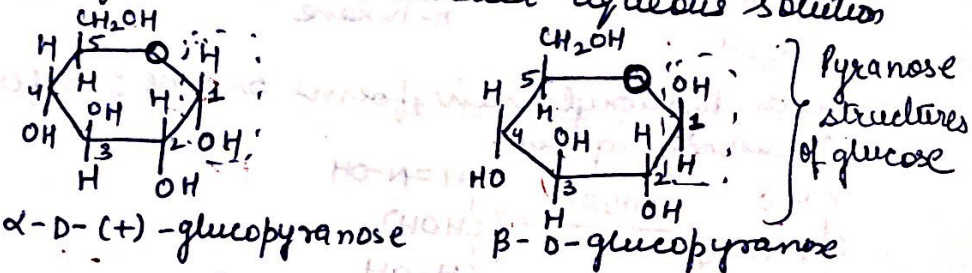
→ **Reactions which can not be explained by open chain glucose structure**

1. Despite having the aldehyde group, glucose does not give 2,4-DNP test, Schiff test and does not form Hydrogen sulphite addition product with $NaHSO_3$.
2. Pentaacetate of glucose does not react with hydroxyl amine indicating absence of $-CHO$ group.
3. α & β forms of glucose could not be explained

→ **ANOMERS:** The pair of diastereomers of aldoses which differ in configuration about C1 carbon atom eg α glucose & β-glucose

→ **Difference between α - β glucose:** α-glucose and β-glucose differ in the configuration of the hydroxyl group at C-1, thus called as anomers. α-glucose is obtained by crystallisation from conc. glucose solution at 303K while β is obtained by crystallisation from hot & saturated aqueous solution at 371 K.

→ ~~MUTARO~~



α-D-(+)-glucopyranose β-D-glucopyranose

→ **MUTAROTATION:** The process involving the gradual change in the optical rotation of either optically active form of carbohydrate in aqueous solution to that of equilibrium mixture

→ **GLYCOSIDIC LINKAGE:** The oxide linkage formed ~~by~~ by a loss of water molecule, which connects the monosaccarides units in oligosaccarides or polysaccarides is called glycosidic linkage.

→ **PRODUCTS OF HYDROLYSIS**

1. Sucrose : α-D-Glucose & β-D-Glucose
2. Maltose : Two α-D glucose units
3. Lactose : β-D-Glucose & β-D-Galactose

→ **REDUCING AND NON-REDUCING SUGARS:**

→ Carbohydrates which reduce Tollen's reagent and fehling solution are called reducing sugars, while those which do not reduce these are called non-reducing sugars. eg Glucose, fructose, maltose and lactose are reducing sugar while sucrose is non-reducing sugar.

→ Reducing sugars contain free aldehyde or ketonic grps.

Why is sucrose not a reducing sugar?
Since the reducing groups of glucose and fructose are involved in glycosidic bond formation, glucose is a non-reducing sugar.

INVERT SUGAR: The hydrolysis of sucrose brings about a change in the sign of rotation from dextro (+) to laevo (-) and the product is named as invert sugar. It is because sucrose on hydrolysis gives dextrorotatory glucose & laevorotatory fructose and the laevorotation of fructose is more than dextrorotation of glucose

COMPONENTS OF STARCH: Amylose and amylopectin
Starch is a polymer of α-glucose.

Amylose	Amylopectin
→ water-soluble component → constitute 15-20% Starch → long unbranched chain with 200-1000 α-D-(+) glucose units held by C_1-C_4 glycosidic linkage	→ insoluble in water → constitute 80-85% starch → Branched chain polymer of α-D-glucose units in which chain is formed by C_1-C_4 glycosidic linkage while branching at C_1-C_6 gly. linkage.

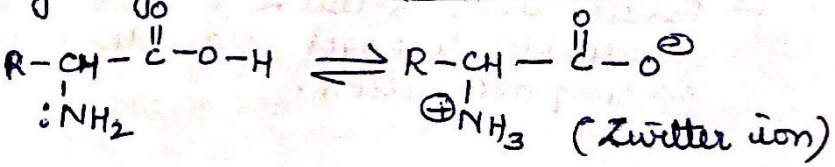
uses of Carbohydrates
1) used as storage molecules as starch in plants and glycogen in animals.
2) cell wall of bacteria and plants is made up of cellulose.

II PROTEINS

Acidic, basic and neutral amino acids :-
→ It depends upon relative no. of amino and carboxyl group in a molecule.
Equal no of amino & carboxyl group make it neutral.
More amino than carboxyl make it basic eg lysine
More carboxyl groups than amino make it acidic eg glutamic acid

Essential and non-essential amino acids.
→ The amino acids which can be synthesised in the body are called non-essential amino acids eg Glutamic acid, Glycine
→ The amino acids which can not be synthesised in the body therefore must be supplied through diet are called as essential amino acids eg. lysine, valine

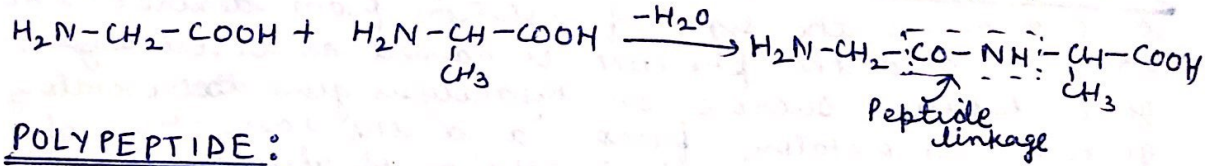
ZWITTER ION :
In aqueous solution, of amino acid, the carboxyl group can lose a proton and amino group can accept a proton, giving rise to dipolar ion called as Zwitter ion.



(Zwitter ion)

PEPTIDE LINKAGE

It is an amide linkage (-CO-NH) which units various amino acid molecules in a dipeptide to polypeptide. The peptide linkage is formed by the elimination of water molecule from amino acid of one molecule and carboxyl group of other.



POLYPEPTIDE:

More than ten amino acid molecules unite together with a peptide bonds to form polypeptide.

FIBROUS PROTEINS	GLOBULAR PROTEINS
→ Linear condensation Polymers of amino acids	→ cross-linked condensation Polymers of acidic and basic amino acids.
→ Generally insoluble in water	→ Soluble in water
→ held together by hydrogen and disulphide bonds to form fibre like str.	→ Coil around to give spherical shape
→ Example: keratin and myosin	→ Insulin & albumin

STRUCTURE OF PROTEINS

1. Primary structure: The specific sequence in which amino acids are linked with each other to form a polypeptide chain is called primary structure
2. Secondary structure: Refers to the arrangement of polypeptide chains giving rise to a particular shape which arises as a result of hydrogen bonding. The two common secondary str are pleated sheet str & (B-sheet) and α-helix.

α helix	B-pleated
→ Polypeptide chain twist into a right handed screw.	All peptide chains are streched out to nearly maximum extension then laid side by side held together by hydrogen bonds
→ Stablised through H-bonds	

3. Tertiary structure: Refers to definite geometric pattern in which the entire protein molecule folds up to produce a specific shape.
   → It gives rise to two major molecular shapes viz. fibrous & globular
   → Forces which stablise 2° & 3° str are H-bonds, disulphide linkages, Van der waals & electrostatic forces of attraction.

...ME IMPORTANT VITAMINS, THEIR SOURCES & DEF. DISEASES

VITAMIN	SOURCES	DEFICIENCY DISEASE
Vitamin A	Fish liver oil, Carrots, butter & milk	Xerophthalmia (Hardning of cornea of eye, Night blindness
Vitamin B_{12}	Meat, fish, egg, curd	Pernicious anaemia (RBC deficient in haemoglobin)
Vitamin C (Ascorbic acid)	Citrus fruits, amla & green leafy vegetables	Scurvy (bleeding gums)
Vitamin D	Exposure to sunlight fish & egg yold	Rickets & osteomalacia
Vit E	vegetable oils like wheat germ oil, sunflower oil etc	Increased fragility of RBCs & muscular weakness

NOTE: Vit C is a powerful antioxidant
Vit D can be synthesized in body.

V NUCLEIC ACIDS (DNA and RNA)

Q Structural difference between DNA and RNA

Ans (i) In DNA, sugar is deoxyribose while in RNA it is ribose
(ii) Pyrimidine base thymine is present in DNA when in RNA, uracil is present
(iii) DNA exist as double helix whearas RNA exists as single strand.

Q Difference between nucleotide and nucleoside

Ans A unit formed by attachment of a base to 1' position of sugar is known as nucleoside.
when neocleoside is linked to phosphoric acid at 5'-position of sugar moiety, we get a nucleotide.

Q Phosphodiester linkage :—

→ It is a linkage between 5' and 3' carbon atoms of the pentose sugar through which nucleotide units are joined together to form polynucleotide.

Q What are the biological functions of nucleic acids?

Ans Replication and Protein synthesis

Q Types of RNA and their functions

Ans Messenger RNA
Ribosomal RNA
Transfer RNA

→ A≡T, C≡G

Q Two strands of DNA are not identical but are complementary.

Ans Thiamine pairs with adenine through two H-bonds & cytosine pairs with guanine through 3, H-bonds.
So opposite each A denine on one strand there is always a thiamine & on opposite guanine, there is cytosine. This means two strands of DNA are complementary to each other.

4. Quaternary str: The overall structure of the protein which arises due to specific spacial arrangement of two or more polypeptide chains called as sub-units is called Quaternary structure.

DENATURATION OF PROTEIN

→ when the protein in its native form is subjected to change in temp or PH or chemical change, the H-bonds are disturbed. Due to this, globules unfold & helix get uncoiled & protein looses its biological activity. This is called protein denaturation.
→ 2° & 3° str are destroyed but 1° str remains intact.
→ example: Coagulation of egg on boiling, curdling of milk.

III ENZYMES

→ Enzymes are the important group of proteins which act as biological catalysts in living systems.
→ They are highly specific in their action.
→ The can speed up an uncatalysed reaction to the extent of ten-million times.
→ They are active at moderate temperature and moderate PH.
→ Even a small amount of enzymes can be highly efficient.

$$\underset{C_{12}H_{22}O_{11}}{\text{Maltose}} \xrightarrow{\text{Maltase}} \underset{2C_6H_{12}O_6}{\text{Glucose}}$$

IV VITAMINS

→ organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of organism.

FAT SOLUBLE AND WATER SOLUBLE VITAMINS

→ Fat soluble vitamins: vitamins which are soluble in fat and oils but insoluble in water. These are vitamins A, D, E, K. These are stored in liver and adipose tissues.
→ Water soluble vitamins: B group vitamins and vitamin C are soluble in water so they are grouped together. They must be supplied in the diet regularly as they are readily excreted in urine & cannot be stored in our body.