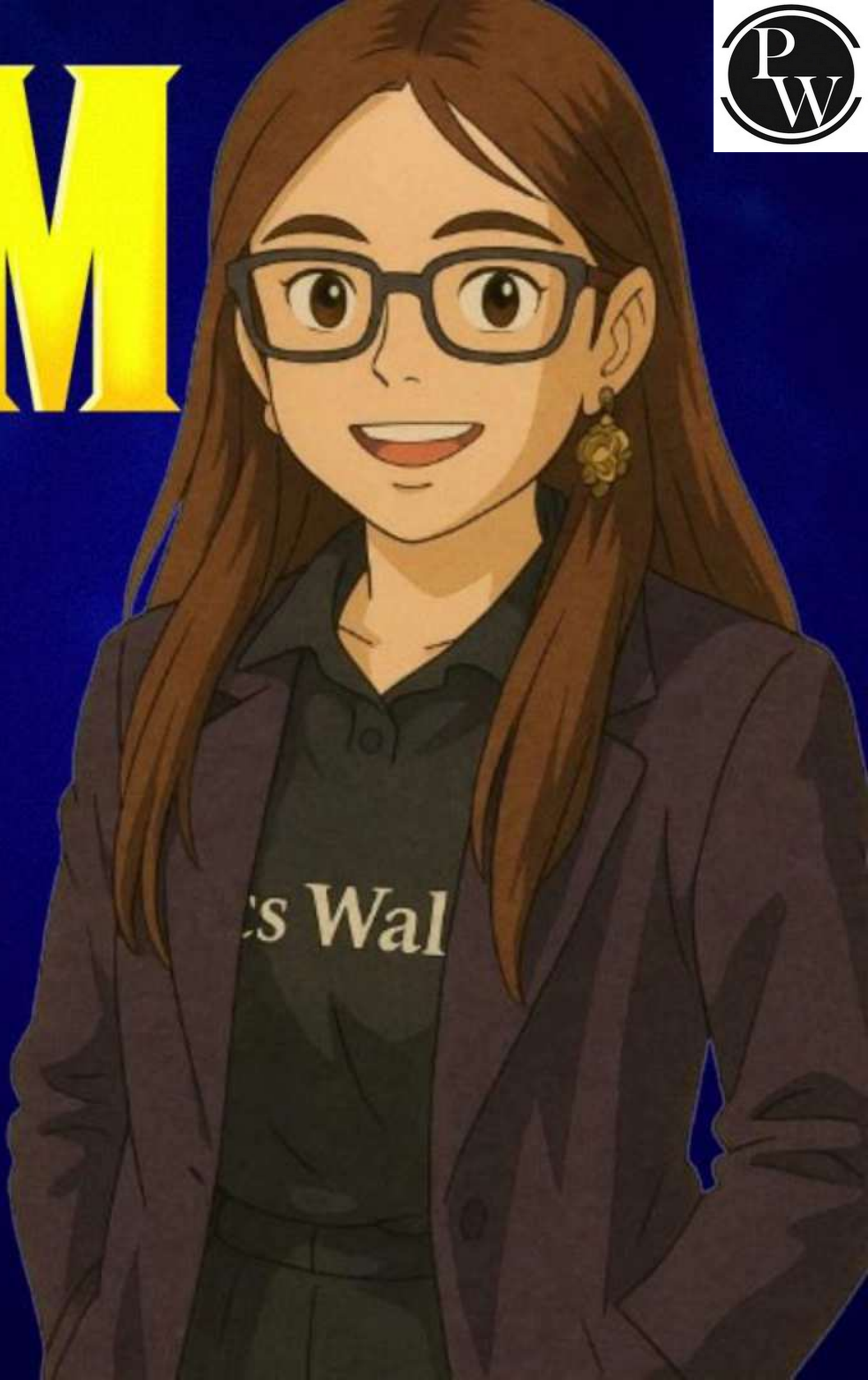
# PARISHRAM

## 2026

# BIOMOLECULES

**CHEMISTRY** **LECTURE-1**

**BY – SHOURYA GROVER (SG) MA'AM**



# TOPICS TO BE COVERED

1. BIOMOLECULES
   Introduction
2. CLASSIFICATION OF CARBOHYDRATES
3. GLUCOSE
4. QUESTIONS


SHOURYA MAM
JOIN MY OFFICIAL TELEGRAM CHANNEL
Physics Wallah
@CHEMISTRYBY
SHOURYAMAM

# MY SHIMMERING STARS

# #SHOURYA'SGALAXY


START

# BIOMOLECULES

# INTRODUCTION

- Biomolecules are the organic molecules that are produced by living organisms and are essential for life processes such as growth, energy production, and reproduction.

# INTRODUCTION

| Type of Biomolecule | Examples | Main Function |
|---|---|---|
| Carbohydrates | Glucose, Starch, Cellulose | Provide energy |
| Proteins | Enzymes, Hormones, Keratin | Body building, metabolism |
| Lipids (Fats & Oils) | Triglycerides, Cholesterol | Energy storage, membrane structure |
| Nucleic Acids | DNA, RNA | Genetic information transfer |
| Vitamins & Minerals | Vitamin C, Iron, Calcium | Regulation and enzyme function |

# CARBOHYDRATES

Hydrates of Carbon

Carbohydrates are organic compounds made up of Carbon (C), Hydrogen (H), and Oxygen (O) — usually in the ratio -$C_x(H_2O)_y$.

# CARBOHYDRATES

$\longrightarrow$ Ex. $C_n(H_2O)_n$

$n=6$, $C_6(H_2O)_6 \rightarrow \underbrace{C_6H_{12}O_6 \text{ (Glucose)}}_{\text{Carbohydrate ✓}}$

~~Carbohydrates are organic compounds made up of Carbon (C), Hydrogen (H), and Oxygen (O) — usually in the ratio -$C_x(H_2O)_y$.~~

Ex. $n=2$

$C_2(H_2O)_2$ or $CH_3COOH$ } Carboxylic Acid

# CARBOHYDRATES

2 min wait

Chirality

many OH gp

poly + hydroxy

Carbohydrates are defined as optically active polyhydroxy aldehyde or Ketone that can or cannot be hydrolysed further. The compounds on further hydrolysis, also produces Carbohydrates.

$-CHO$

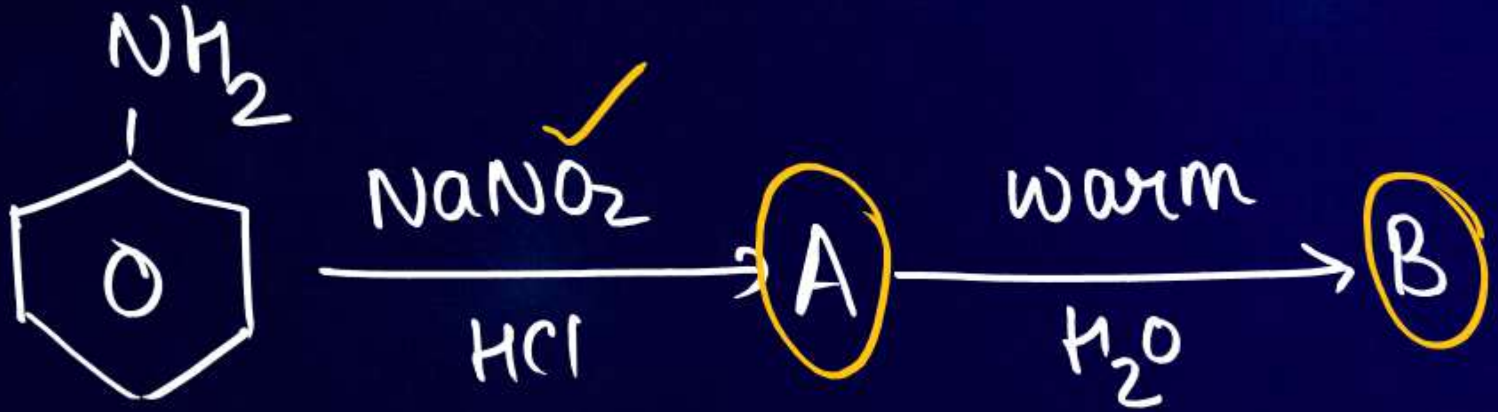
$-\overset{\displaystyle O}{\overset{\|}{C}}-$ or $-CO-$

Sucrose
Lactose
Maltose

Ex. Glucose, Fructose, Ribose etc.

# MOP OF CARBOHYDRATES

Jab tk voice aa jaye iska answer batao :




A, B ?

# CLASSIFICATION OF CARBOHYDRATES

on the basis of no of products obtained on hydrolysis

| Monosaccharides | Oligosaccharides | Polysaccharides |
| --- | --- | --- |
| 1 unit | 2-10 unit | many units |
| They can't be further hydrolysed. | They further undergo hydrolysis to yield 2-10 Monosaccharides. | They undergo hydrolysis to yield many units (Mono). |
| Ex. Glucose, Ribose, Fructose, Galactose. | Ex. Sucrose, Maltose, Lactose. | Ex. Starch, Cellulose, Glycogen |

# CLASSIFICATION

MONOSACCHARIDE - They can't hydrolysed.

→ Glucose
↳ $C_6H_{12}O_6$ optically active, polyhydroxy aldehyde

→ Fructose
↳ $C_6H_{12}O_6$ optically active polyhydroxy Ketone

# CLASSIFICATION

## OLIGOSACCHARIDES- 2 to 10

Ex. Sucrose

Glucose Fructose

$$\underbrace{C_{12}H_{22}O_{11}}_{\text{(disaccharides)}} \xrightarrow{\Delta} \underbrace{C_6H_{12}O_6 + C_6H_{12}O_6}_{\text{2 Monosaccharide unit}}$$

$$\underbrace{\text{2 Monosaccharide unit}}_{\text{disaccharides}}$$

# CLASSIFICATION

## OLIGOSACCHARIDES-

Ex. Maltose $\xrightarrow{\Delta}$ Glucose + Glucose
(disaccharide)

Ex. Lactose $\xrightarrow{\Delta}$ Glucose + Galactose
(disaccharide)

Monosaccharide →

| Carbon atoms | General term | Aldehyde | Ketone |
|---|---|---|---|
| 3 | Triose | Aldotriose | Ketotriose |
| 4 | Tetrose | Aldotetrose | Ketotetrose |
| 5 | Pentose | Aldopentose | Ketopentose |
| 6 | Hexose | Aldohexose | Ketohexose |
| 7 | Heptose | Aldoheptose | Ketoheptose |

Ex. Glucose : $C_6H_{12}O_6 \rightarrow$ aldohexose

Fructose : $C_6H_{12}O_6 \longrightarrow$ Ketohexose

# CARBOHYDRATES

They can also be classified into Reducing sugar or Non Reducing sugars.

Reducing Sugar ⟶ Sugar which Reduces Tollen's Reagent Test or Fehling sol.

Non Reducing Sugar ⟶ Sugars which don't Reduce them.

# MOP OF CARBOHYDRATES

## 1. GLUCOSE

It is Monosaccharide

It is aldohexose

Molecular Formula : $C_6H_{12}O_6$

Functional gp - Aldehyde

Molecular Mass : 180

# MOP OF CARBOHYDRATES

(a) FROM SUCROSE
(CANE SUGAR)

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} \xrightarrow[H_2SO_4]{\text{dil HCl}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

# MOP OF CARBOHYDRATES

(b) From starch

CUET PYQ

Boards.

Formula of starch ?

$$(C_6H_{10}O_5)_n \xrightarrow[\text{dil } H_2SO_4]{\Delta,\ 393\text{-}8K} nC_6H_{12}O_6$$

Glucose

This is the Commercial Method of preparation of Glucose.

## HOMEWORK

1. COMPLETE NOTES
2. DRAW STRUCTURE AGAIN
3. REVISE NOTES
4. ~~FINISH DHA/DPP~~

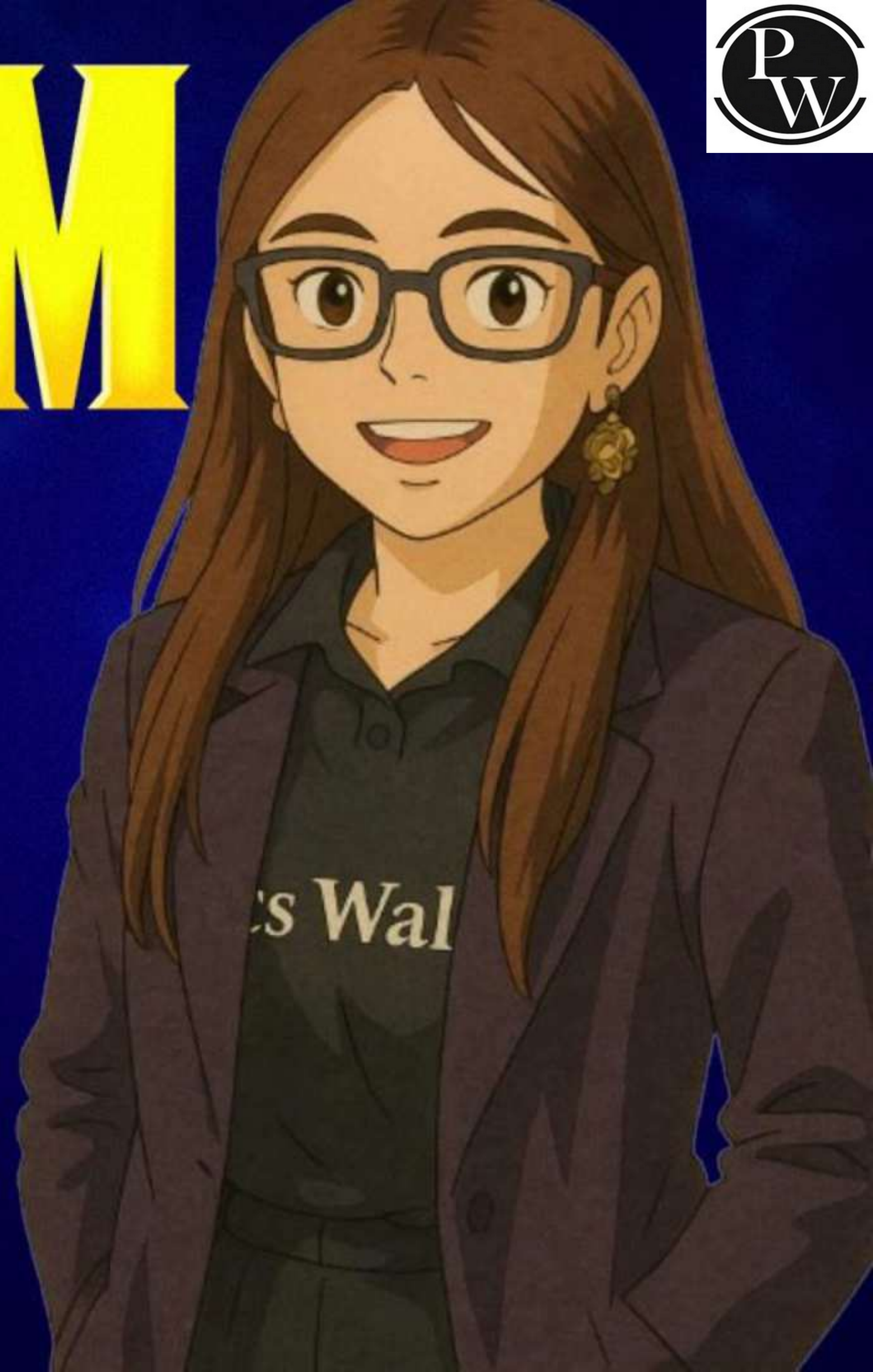
# PARISHRAM

## 2026

## BIOMOLECULES

**CHEMISTRY** **LECTURE-2**

**BY – SHOURYA GROVER (SG) MA'AM**



# TOPICS TO BE COVERED

1. GLUCOSE
2. CYCLIC STRUCTURE OF GLUCOSE
3. FRUCTOSE
4. QUE

# MY SHIMMERING STARS

# #SHOURYA'SGALAXY


START

# GLUCOSE ✓

# GLUCOSE

dextorotatory in Nature [It will rotate PPL to Right dirn].

Glucose is an aldohexose and is also known as dextrose. It is the monomer of many of the larger carbohydrates, namely starch, cellulose. It is probably the most abundant organic compound on earth.

# EVIDENCE FOR STRUCTURE OF GLUCOSE

1. Molecular Formula of Glucose $C_6H_{12}O_6$.

2. $$CHO-(CHOH)_4-CH_2OH \xrightarrow[\Delta]{HI} \text{n-Hexane}$$

$(CH_3-CH_2-CH_2-CH_2-CH_2-CH_3)$

Glucose on prolonged heating with HI produces n-Hexane.

6 Carbon atoms are present in straight chain.

# EVIDENCE FOR STRUCTURE OF GLUCOSE

3.

$$\underset{\text{Glucose}}{\begin{array}{c} O \\ \| \\ H-C \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} + H_2N-OH \xrightarrow[\text{hydroxylamine}\ -H_2O]{NH_2OH} \begin{array}{c} HC=N-OH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \Bigg\} \text{oxime}$$

$$\begin{array}{c} O^{\delta -} \\ \| \\ H-C^{\delta +} \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \xrightarrow[\text{hydrogencyanide}]{\overset{+}{H}\overset{-}{C}N} \begin{array}{c} H-C\begin{array}{l} OH \\ CN \end{array} \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \Bigg\} \text{cyanohydrin}$$

Confirms presence of $\begin{array}{c} O \\ \| \\ -C- \end{array}$ gp

# EVIDENCE FOR STRUCTURE OF GLUCOSE

When glucose reacts with hydroxylamine & hydrogencyanide, it will yield oxime and cyanohydrin respectively.

This confirms the presence of $-CO-$ ($-\overset{O}{\overset{\|}{C}}-$) group.

(4.)

$$\underset{\text{Glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} \xrightarrow[\text{(Mild oxidising agent)}]{Br_2\ \text{water}} \underset{\text{Gluconic acid}}{\begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}}$$

Confirms aldehyde gp.

# EVIDENCE FOR STRUCTURE OF GLUCOSE

5.

$$\underset{\text{Glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} \xrightarrow[\substack{CH_3-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-CH_3}]{\text{acetic anhydride}} \begin{array}{c} CHO \\ | \\ (CH-O-\underset{\underset{O}{\|}}{C}-CH_3)_4 \\ | \\ CH_2-O-\underset{\underset{O}{\|}}{C}-CH_3 \end{array}$$

This confirms the presence of 5 OH gps.

6.

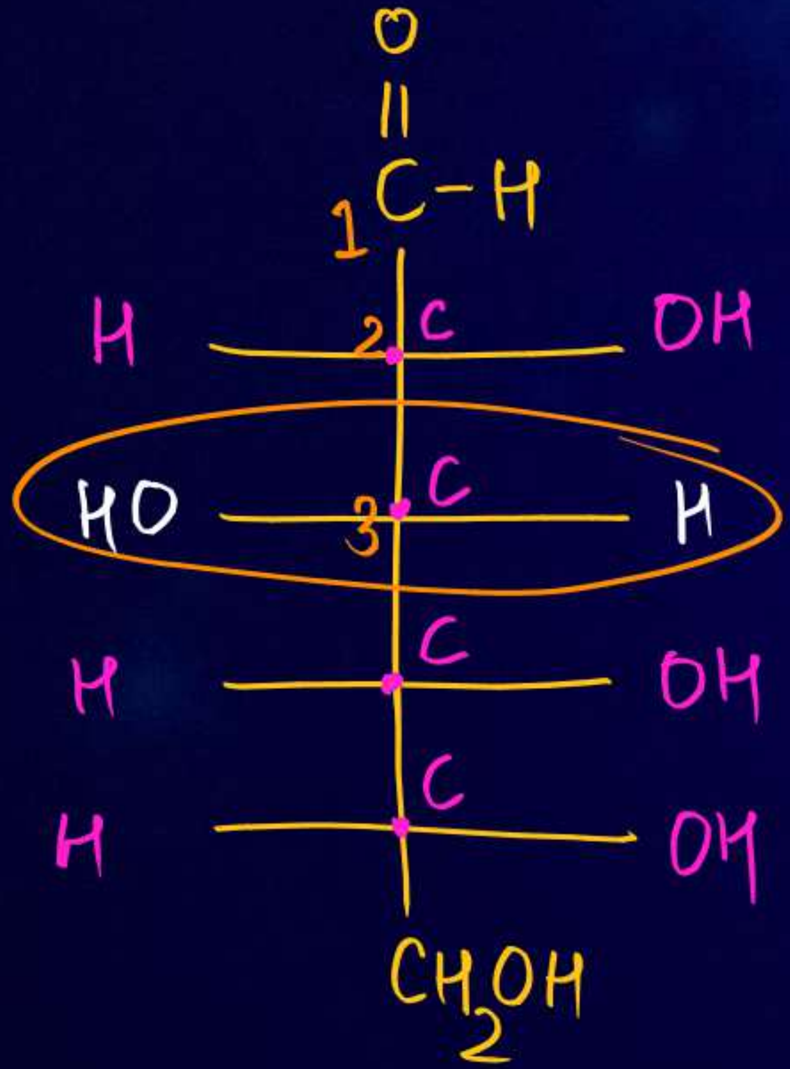
$$\underset{\text{glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} \xrightarrow[\text{acid}]{\text{Nitric}} \underset{\text{saccharic acid (dicarboxylic acid)}}{\begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ COOH \end{array}} \longleftarrow \underset{\text{gluconic}}{\begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}}$$

confirms presence of 1° OH.

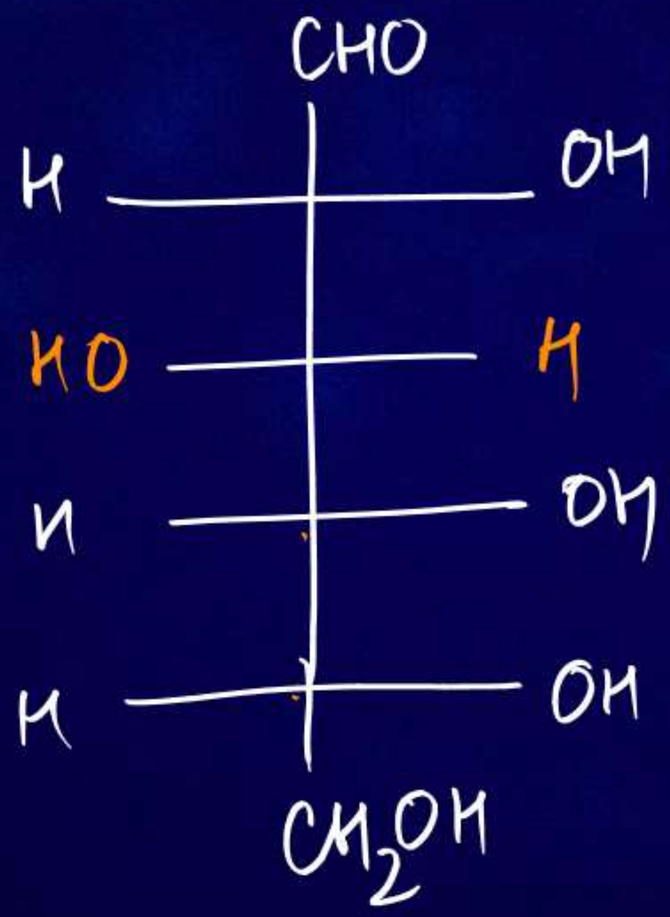
# GLUCOSE

$$CHO - (CHOH)_4 - CH_2OH$$

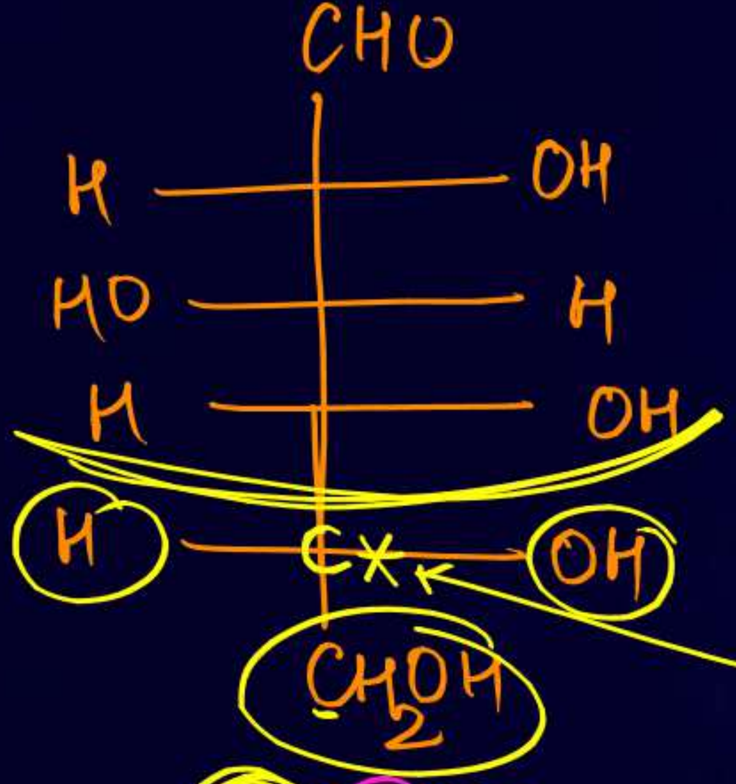
Glucose



or



D (+) Glucose




D (+) Glucose

A carbon which has 4 different gps.

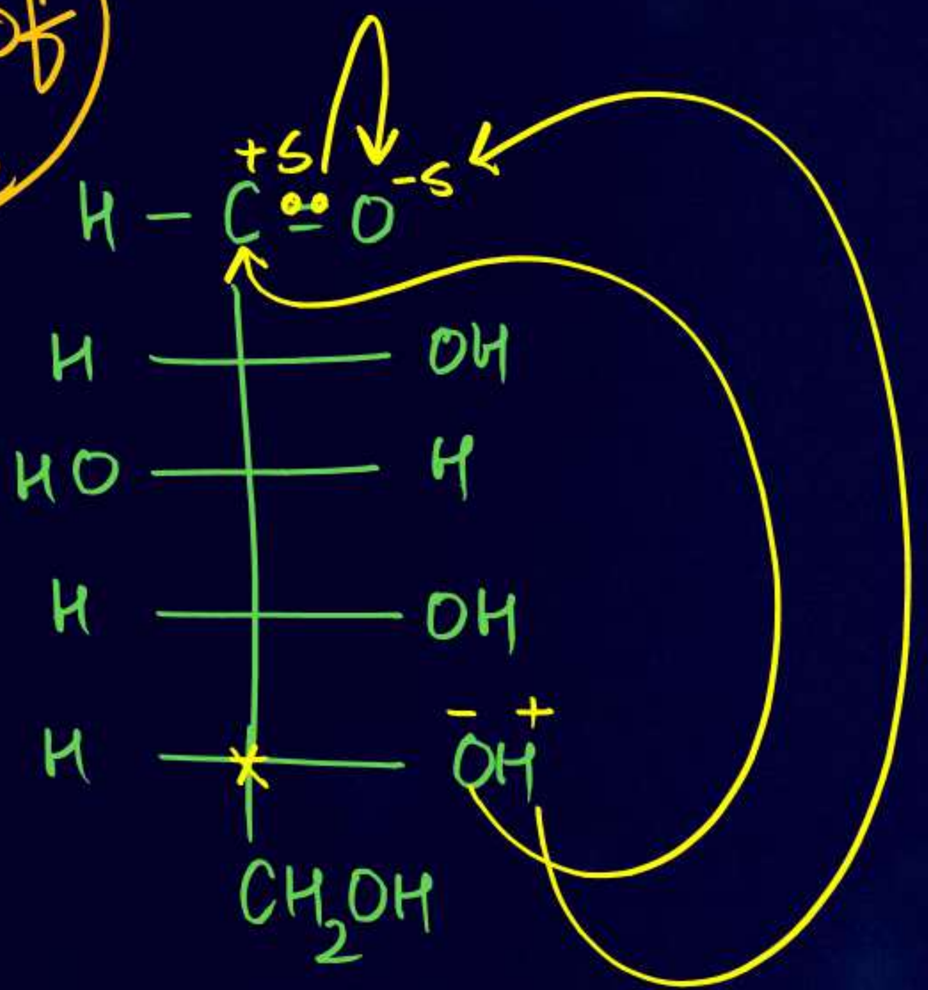
last asymmetric Carbon (Chiral C)

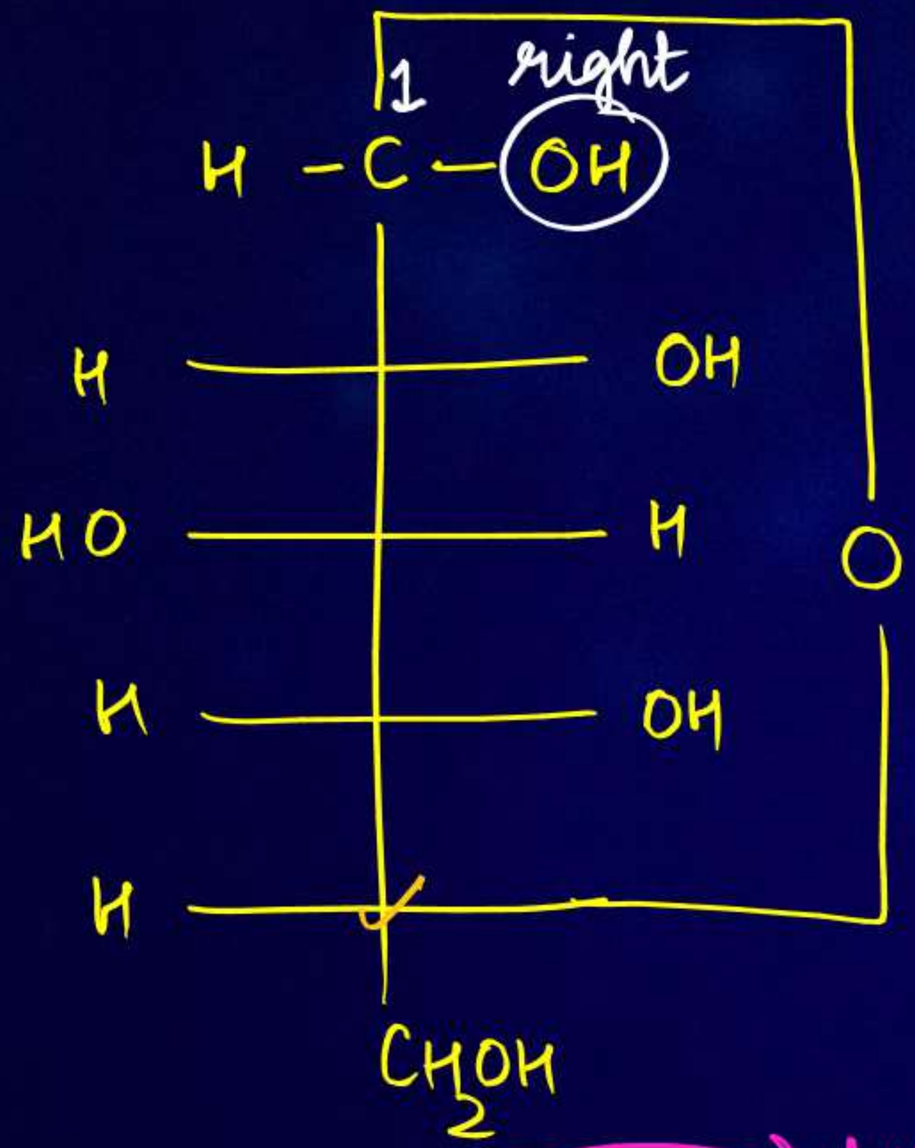
When OH (hydroxyl) gp is present on Right side of last chiral C.

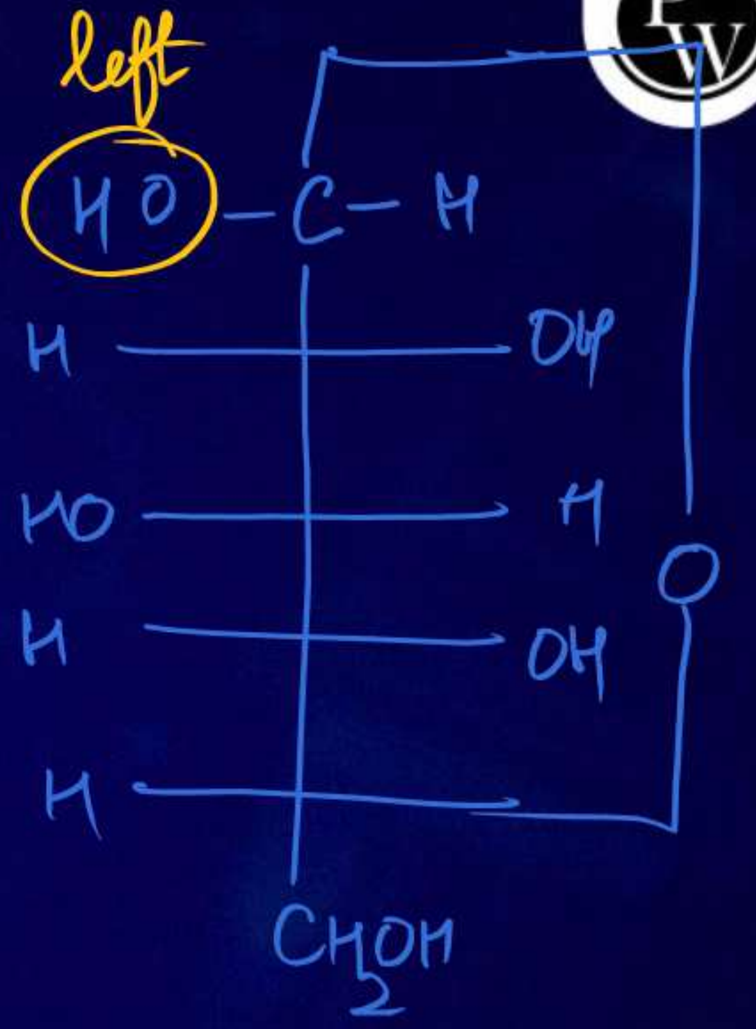
(+) Represents dextorotatory Nature
It is also represented as 'd'.

* 'd' and 'l' are used to indicate dextorotatory or leaveorotatory nature of structure. It may also be written as (+) or (–) respectively. It has no Relation with 'D' & 'L'.

# Forms of Glucose




β- D (+) Glucose

α- D(+) Glucose → dextrorotatory

When OH is present on Right side on 1st C

last Chiral C पर OH Right

anomers


SHOURYA MAM
JOIN MY OFFICIAL TELEGRAM CHANNEL
Physics Wallah
@CHEMISTRYBY
SHOURYAMAM

# HOMEWORK

1. COMPLETE NOTES
2. DRAW STRUCTURE AGAIN
3. REVISE NOTES
4. FINISH DHA/DPP

Bye Parishram 2026

Ke

Shimmering Stars ☆

(Chamakte Sitare)

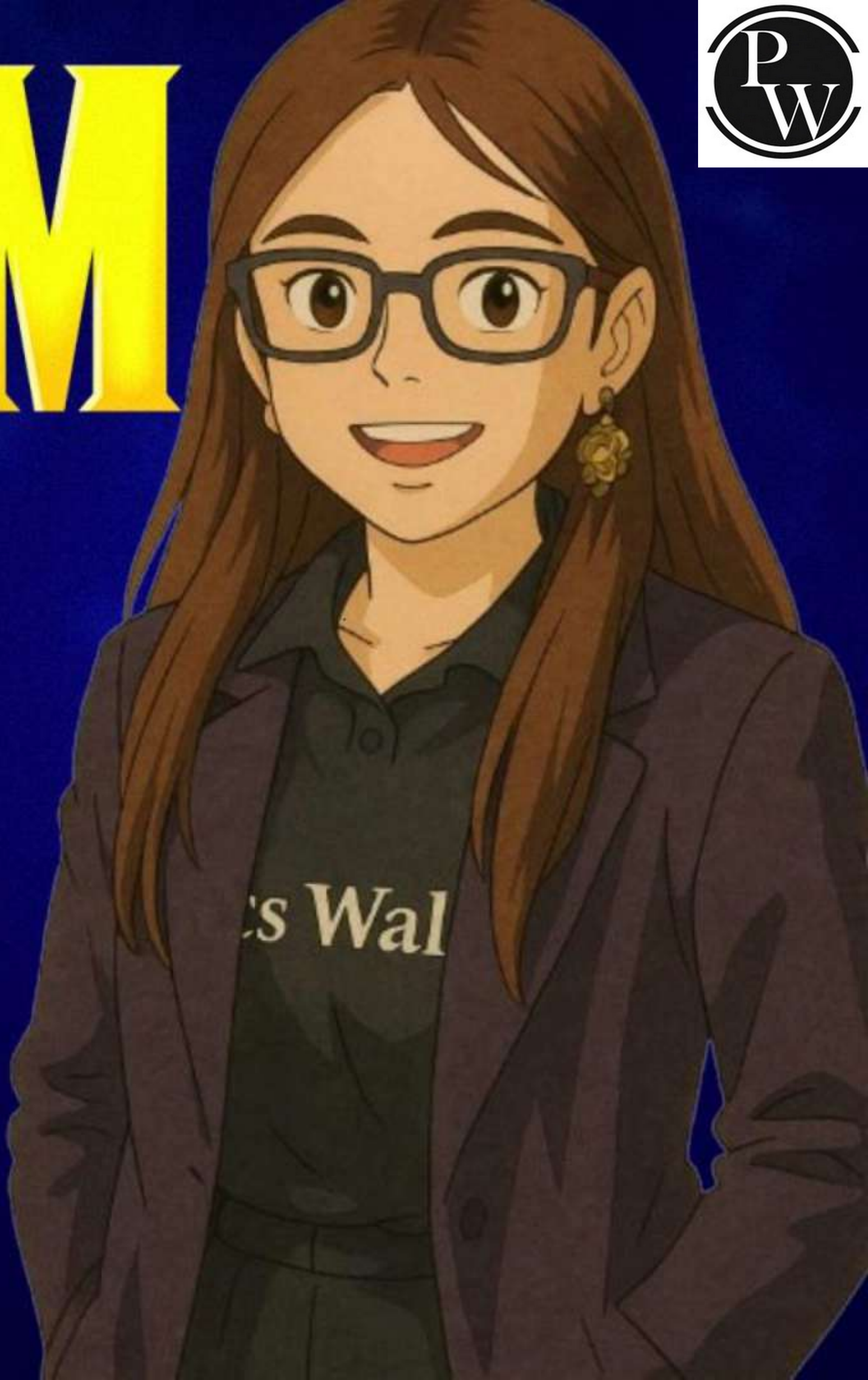
# PARISHRAM

## 2026

## BIOMOLECULES

CHEMISTRY LECTURE-3

BY – SHOURYA GROVER (SG) MA'AM



# TOPICS TO BE COVERED

1. FRUCTOSE

   Structures

2. DIASACCHARIDE

3. POLYSACHHARIDE , PROTEIN , NUCLEIC ACID

4. NCERT READING

# MY SHIMMERING STARS

# #SHOURYA'SGALAXY


START

## GLUCOSE

**Despite having the aldehyde group, glucose does not give Schiff's test and it does not form the hydrogensulphite addition product with NaHSO3 .**

# GLUCOSE

The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free —CHO group.

## GLUCOSE

anomers

Glucose is found to exist in two different crystalline forms which are named as α and β. The a-form of glucose (m.p. 419 K) is obtained by crystallisation from concentrated solution of glucose at 303 K while the β-form (m.p. 423 K) is obtained by crystallisation from hot and saturated aqueous solution at 371 K.

# FRUCTOSE

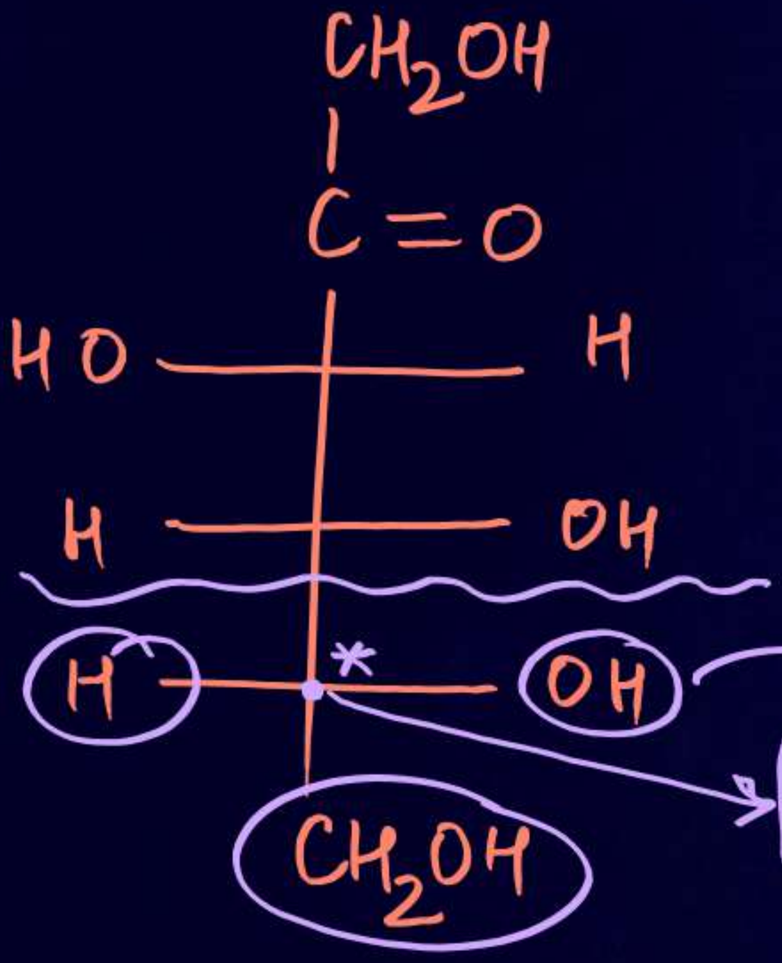
# FRUCTOSE

It exist in free & combined state.

- ✓ Ketohexose
- ✓ Molecular Formula :- $C_6H_{12}O_6$ } Functional gp :- Ketone ✓
- ✓ It is laevorotatory in Nature.

PPL rotate in left direction (anticlockwise)

→ 'l' or (−) } Representation.




OH is present on Right side

↓

'D'.

$\boxed{\text{Chiral Carbon}}$

↓

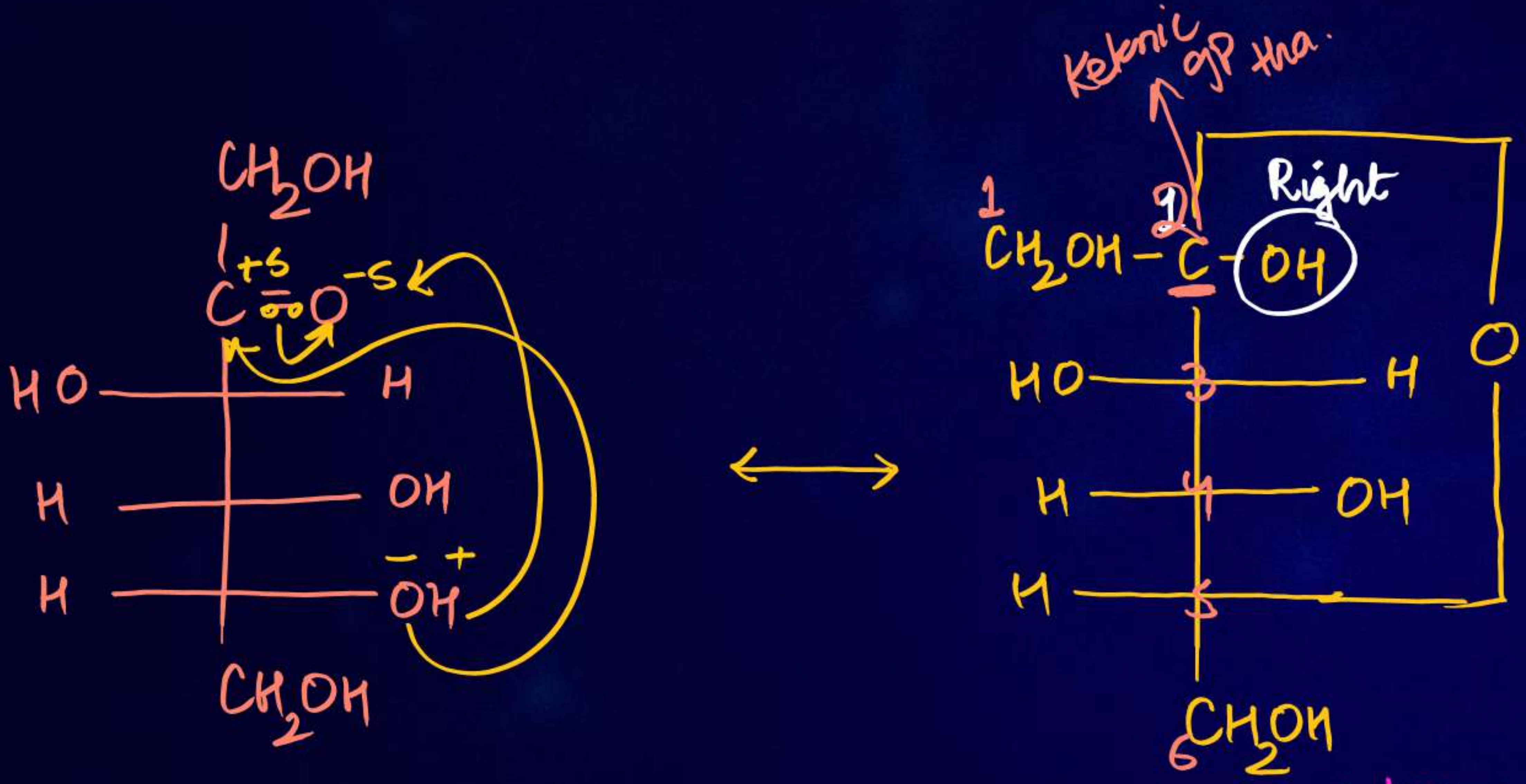
last

D (–) fructose

$\underbrace{(-)\ \text{f}}$

↓

laeveorotatory Nature or 'l' or (–).

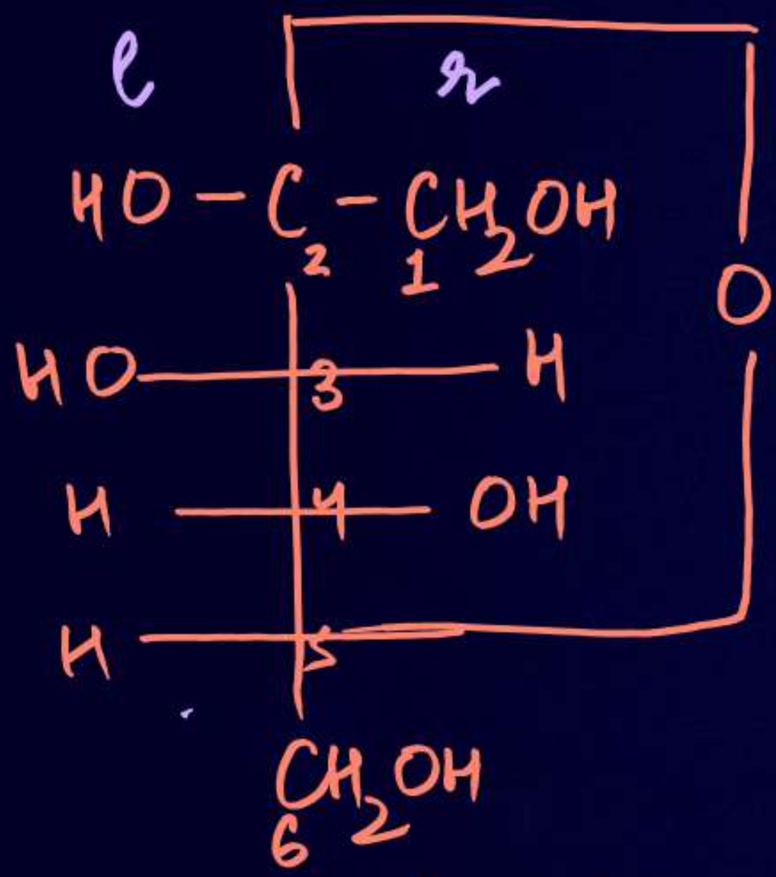



laevorotatory

$\alpha$ - D (−) fructose

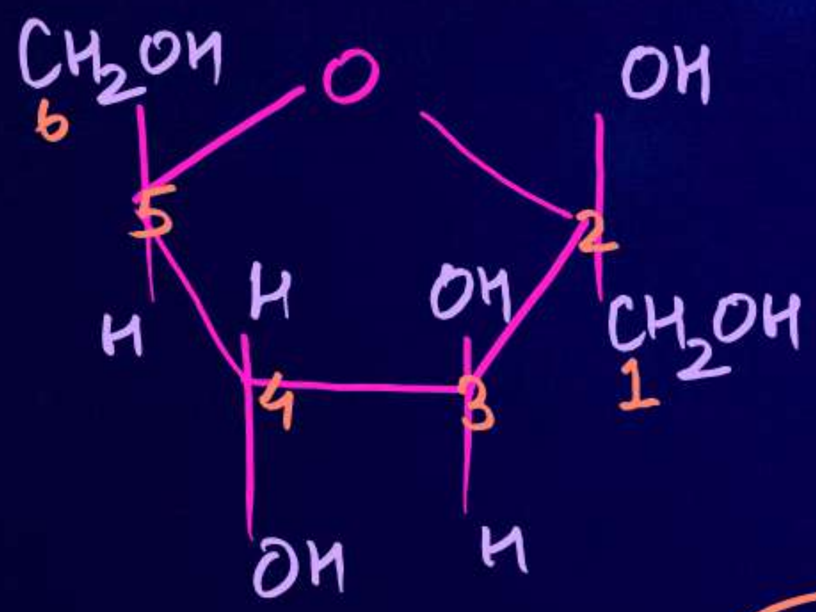
When OH gp is present on Right side of 2nd ~~1st~~ carbon.

It is used for representing OH on Right side of last asymmetric (chiral) carbon.



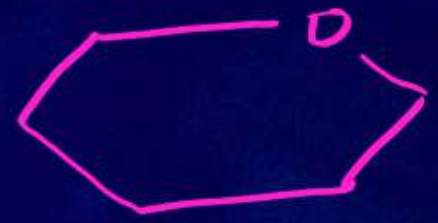

β-D(−) fructose

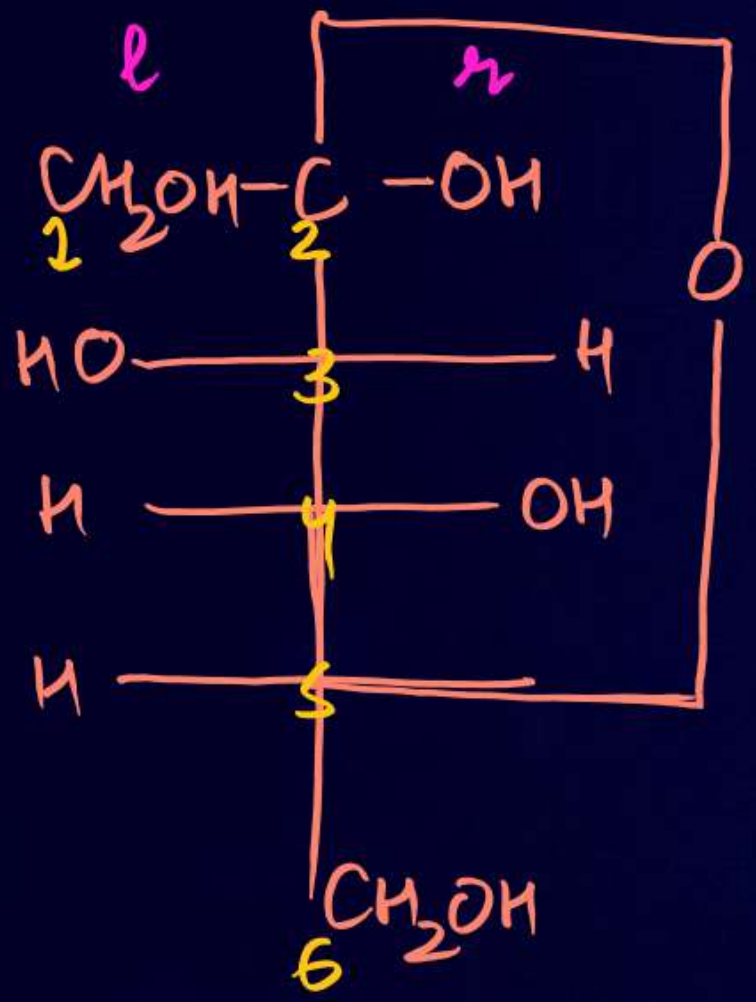
left → top
right → Bottom

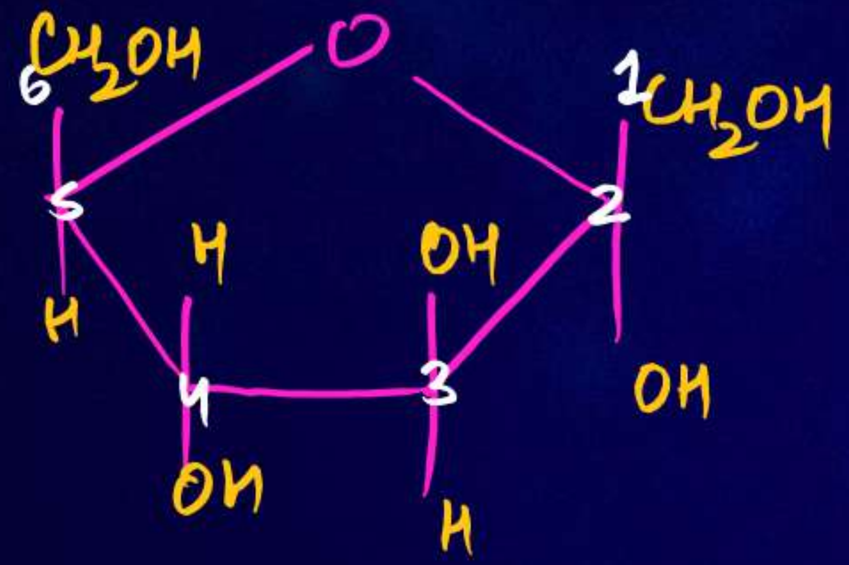



β-D(−) fructofuranose

Pyranose







α ✓

Pyran

Ketonic 6C

α – D – (+) – Glucopyranose

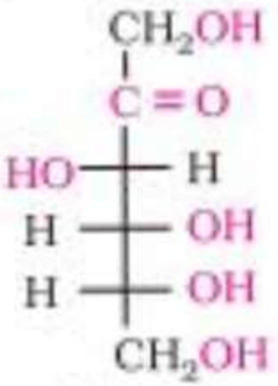
β – D – (+) – Glucopyranose

**10.1.2.2 Fructose**

Fructose is an important ketohexose. It is obtained along with glucose by the hydrolysis of disaccharide, sucrose. It is a natural monosaccharide found in fruits, honey and vegetables. In its pure form it is used as a sweetner. It is also an important ketohexose.

**Structure of Fructose**

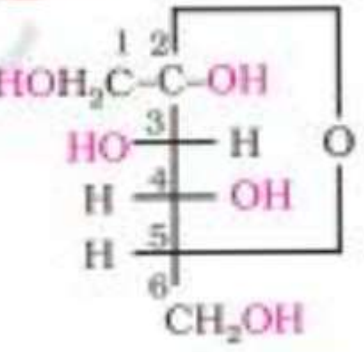
Fructose also has the molecular formula $C_6H_{12}O_6$ and on the basis of its reactions it was found to contain a ketonic functional group at carbon number 2 and six carbons in straight chain as in the case of glucose. It belongs to D-series and is a laevorotatory compound. It is appropriately written as $\boxed{\text{D-(–)-fructose.}}$ Its open chain structure is as shown.



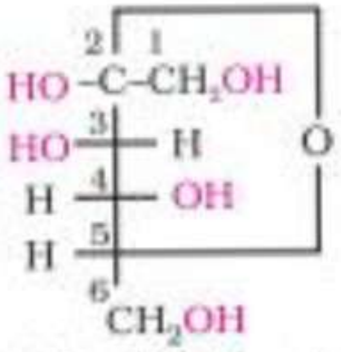
D – (–) – Fructose

It also exists in two cyclic forms which are obtained by the addition of —OH at C5 to the (>C=O) group. The ring, thus formed is a five membered ring and is named as furanose with analogy to the compound furan. [Furan is a five membered cyclic compound with one oxygen and four carbon atoms.] PYQ → CUET | NEET | BOARD

Furan



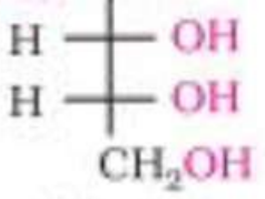
α – D – (–) – Fructofuranose



β – D – (–) – Fructofuranose

The cyclic structures of two anomers of fructose are represented by Haworth structures as given.

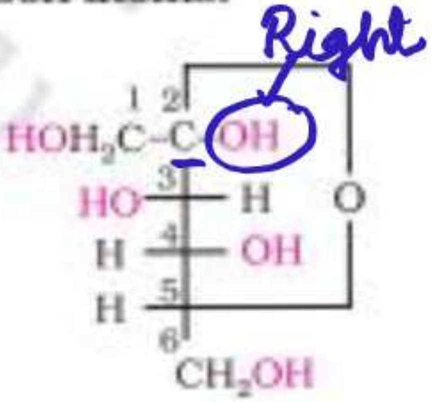
carbons in straight chain as in the case of glucose. It belongs to D-series and is a laevorotatory compound. It is appropriately written as D-(–)-fructose. Its open chain structure is as shown.



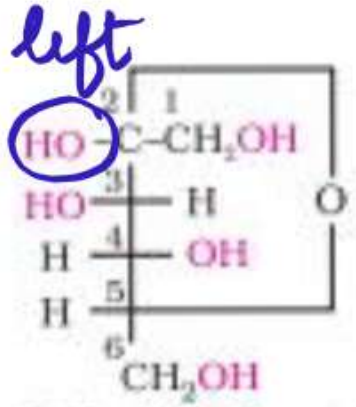

D – (–) – Fructose

It also exists in two cyclic forms which are obtained by the addition of —OH at C5 to the ($\rangle$C=O) group. The ring, thus formed is a five membered ring and is named as furanose with analogy to the compound furan. Furan is a five membered cyclic compound with one oxygen and four carbon atoms.


Furan



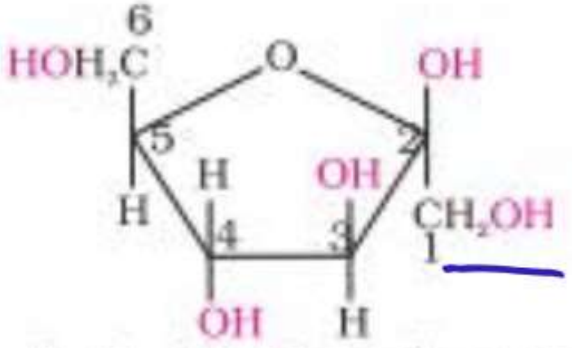

α – D – (–) – Fructofuranose




β – D – (–) – Fructofuranose

The cyclic structures of two anomers of fructose are represented by Haworth structures as given.

α – D – (–) – Fructofuranose



β – D – (–) – Fructofuranose



Reprint 2025-26

# DIASACCHARIDES

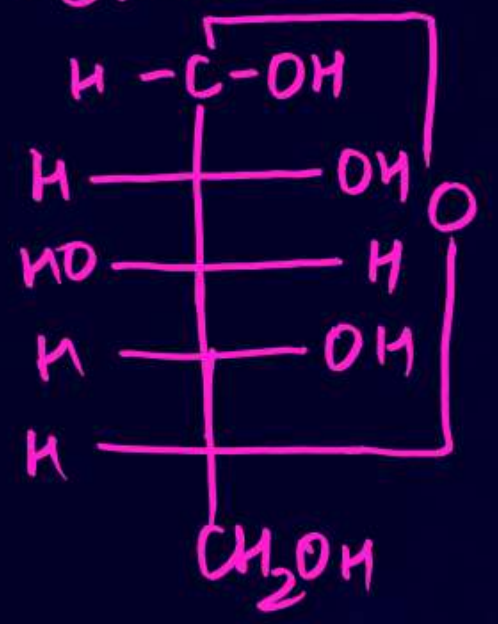
$\underbrace{\text{DIASACCHARIDES}}$

Carbohydrates which on hydrolysis yields 2 Mono. unit.

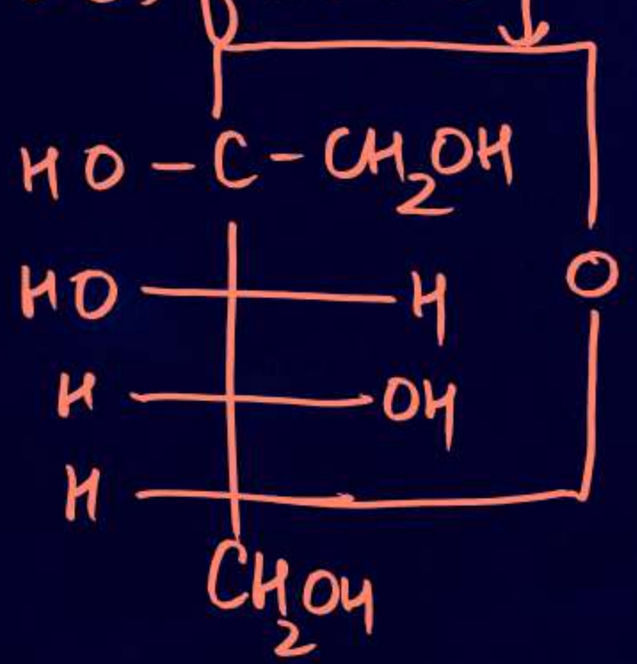
# SUCROSE

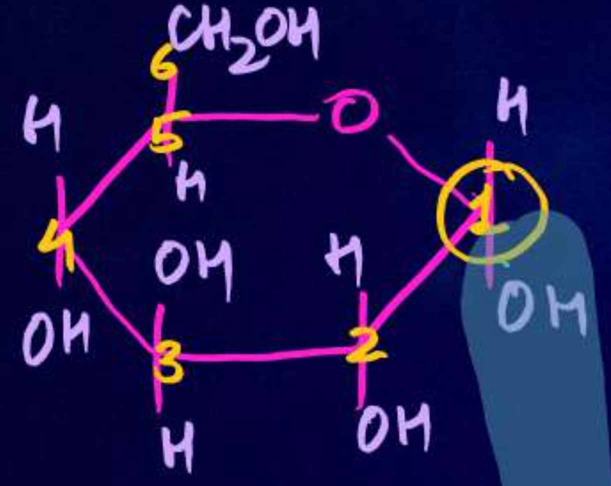
- Also called Cane sugar.
- ✓ Also called Invert sugar.
- ✓ It is Non Reducing sugar } PYQ.
- ✓ Molecular Formula :- $C_{12}H_{22}O_{11}$
- ✓ It also contains glycosidic linkage.
- ✓ It is formed from $C_1$ of $\alpha$-D(+) Glucose & $C_2$ of $\beta$-D(−) fructose.

α-D(+) Glucose

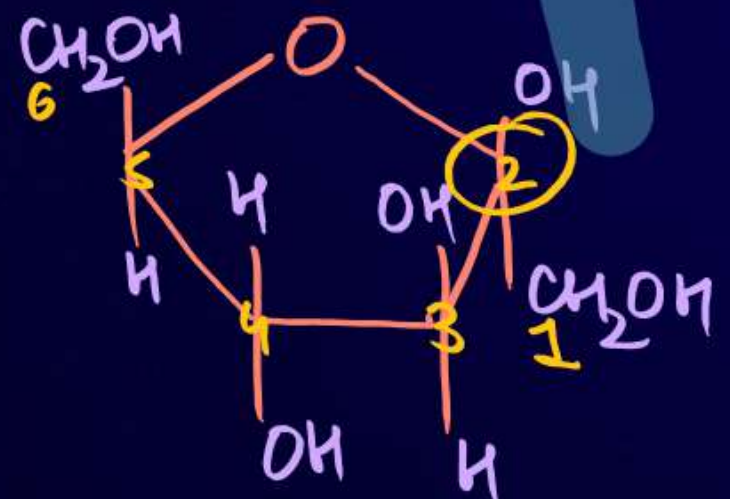



β-D(–) fructose

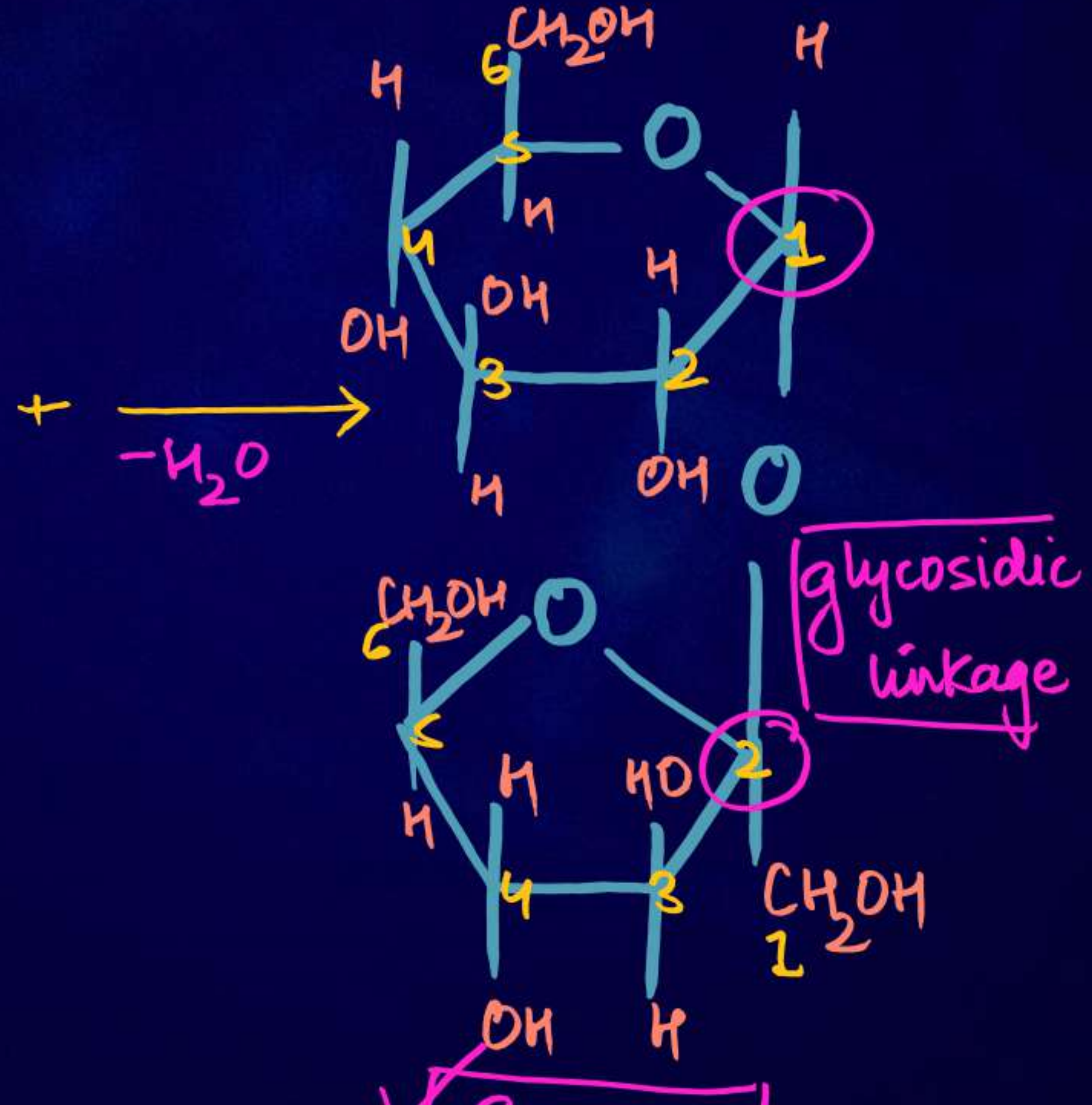


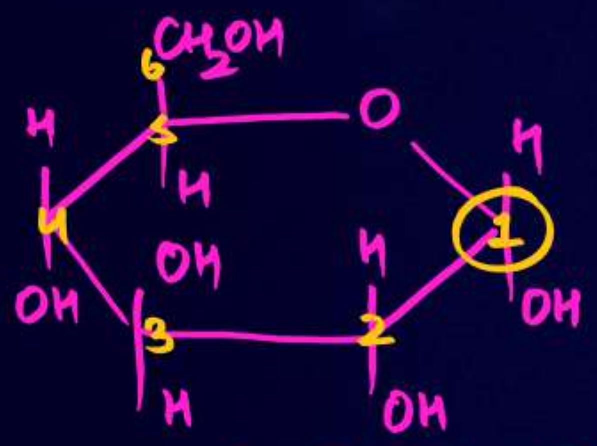

α-D(+) Glucopyranose



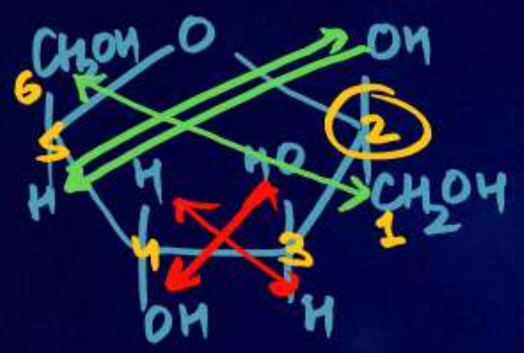

β-D(–) fructofuranose




Sucrose

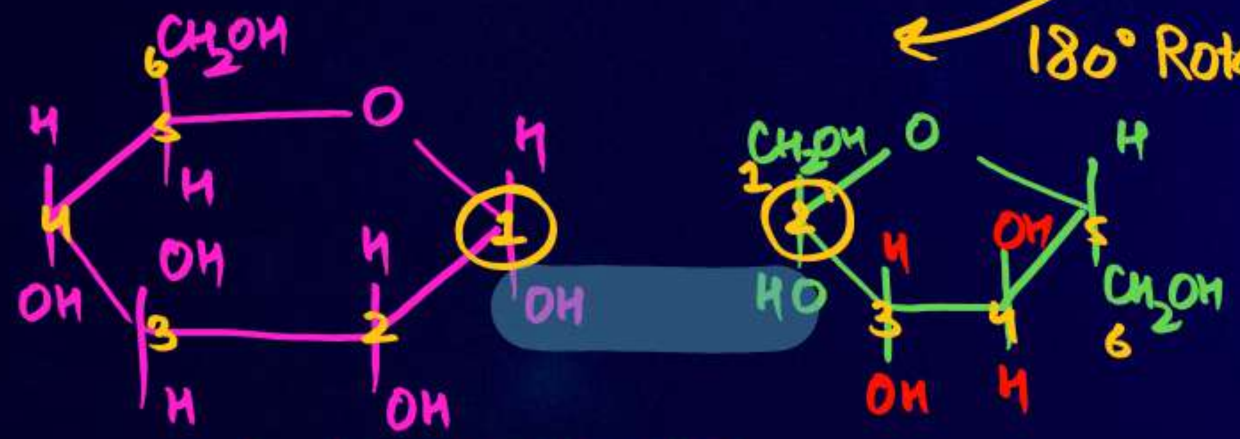


α-D (+) Glucopyranose

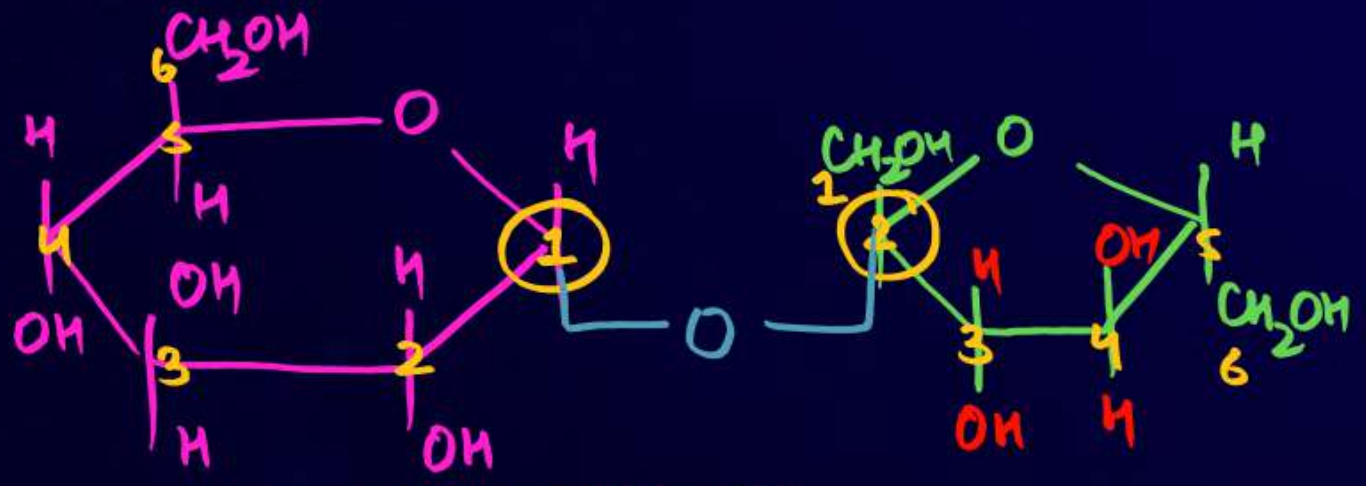


β-D (-) fructofuranose

180° Rotation



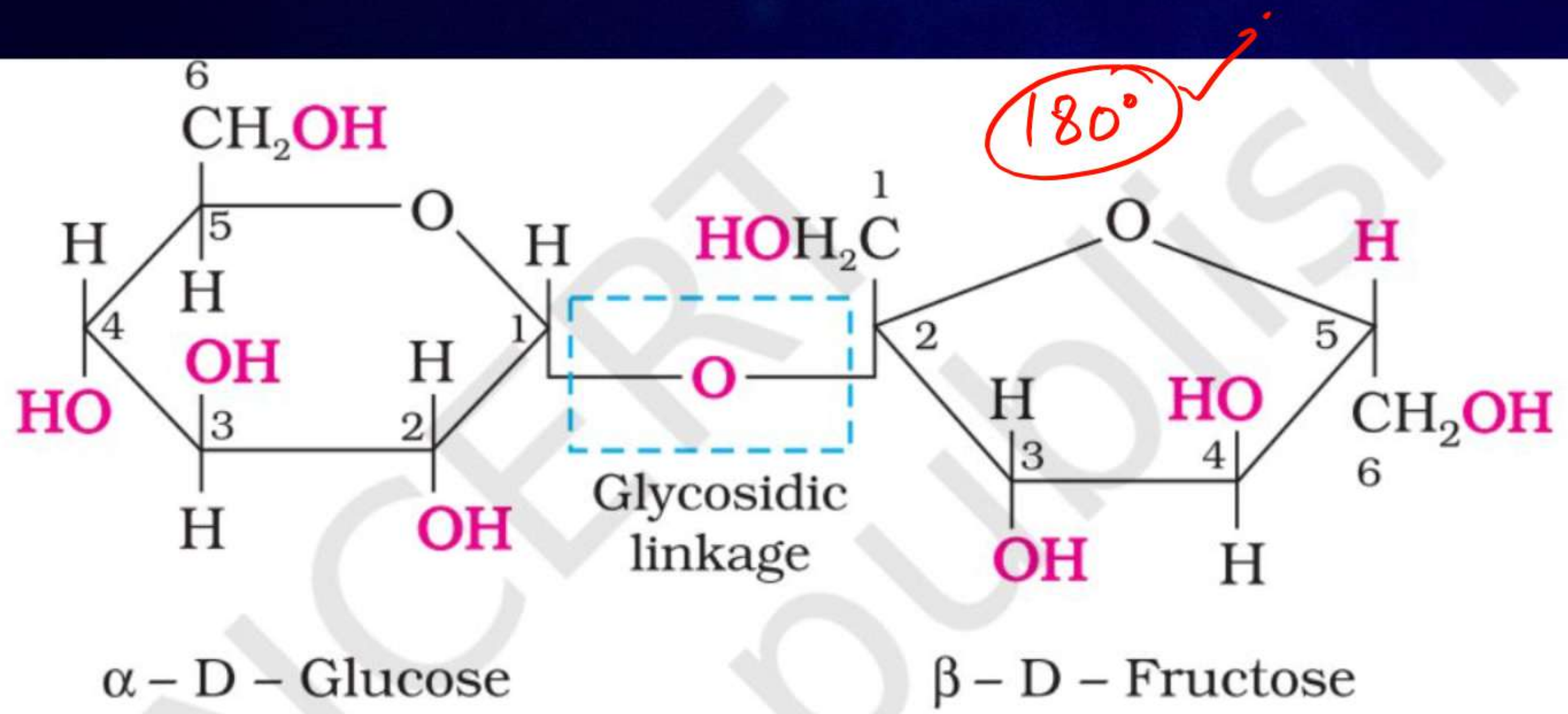
α-D (+) Glucopyranose



α-D (+) Glucopyranose

Sucrose

# SUCROSE




**Sucrose**

## 10.1.3 Disaccharides

You have already read that disaccharides on hydrolysis with dilute acids or enzymes yield two molecules of either the same or different monosaccharides. The two monosaccharides are joined together by an oxide linkage formed by the loss of a water molecule. Such a linkage between two monosaccharide units through oxygen atom is called *glycosidic linkage*.

PYQ

In disaccharides, if the reducing groups of monosaccharides i.e., aldehydic or ketonic groups are bonded, these are non-reducing sugars, e.g. sucrose. On the other hand, sugars in which these functional groups are free, are called reducing sugars, for example, maltose and lactose.

Board.

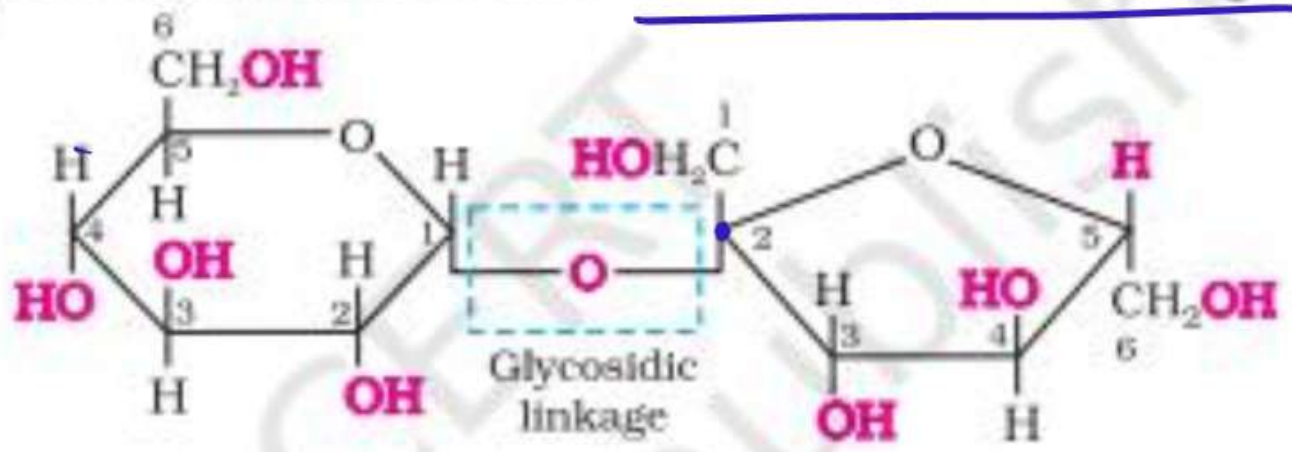
Which disaccharide is Non Reducing sugar among the following :-
a) Sucrose
b) Maltose
c) Lactose
d) All

(i) *Sucrose*: One of the common disaccharides is sucrose which on hydrolysis gives equimolar mixture of D-(+)-glucose and D-(-) fructose.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\text{D-(+)-Glucose}}{C_6H_{12}O_6} + \underset{\text{D-(-)-Fructose}}{C_6H_{12}O_6}$$

These two monosaccharides are held together by a glycosidic linkage between C1 of α-D-glucose and C2 of β-D-fructose. Since the reducing groups of glucose and fructose are involved in glycosidic bond formation, sucrose is a non reducing sugar.

PYQ.



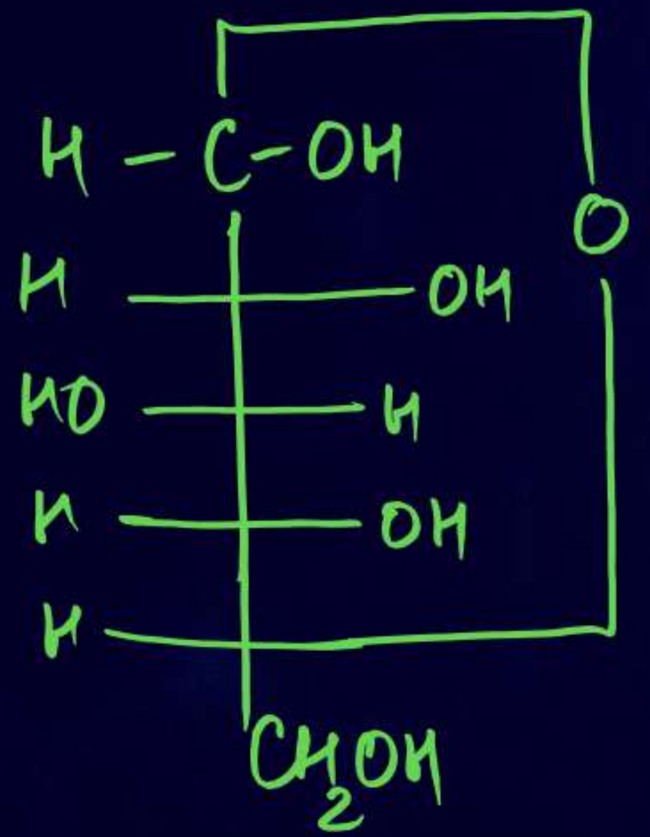
# SUCROSE

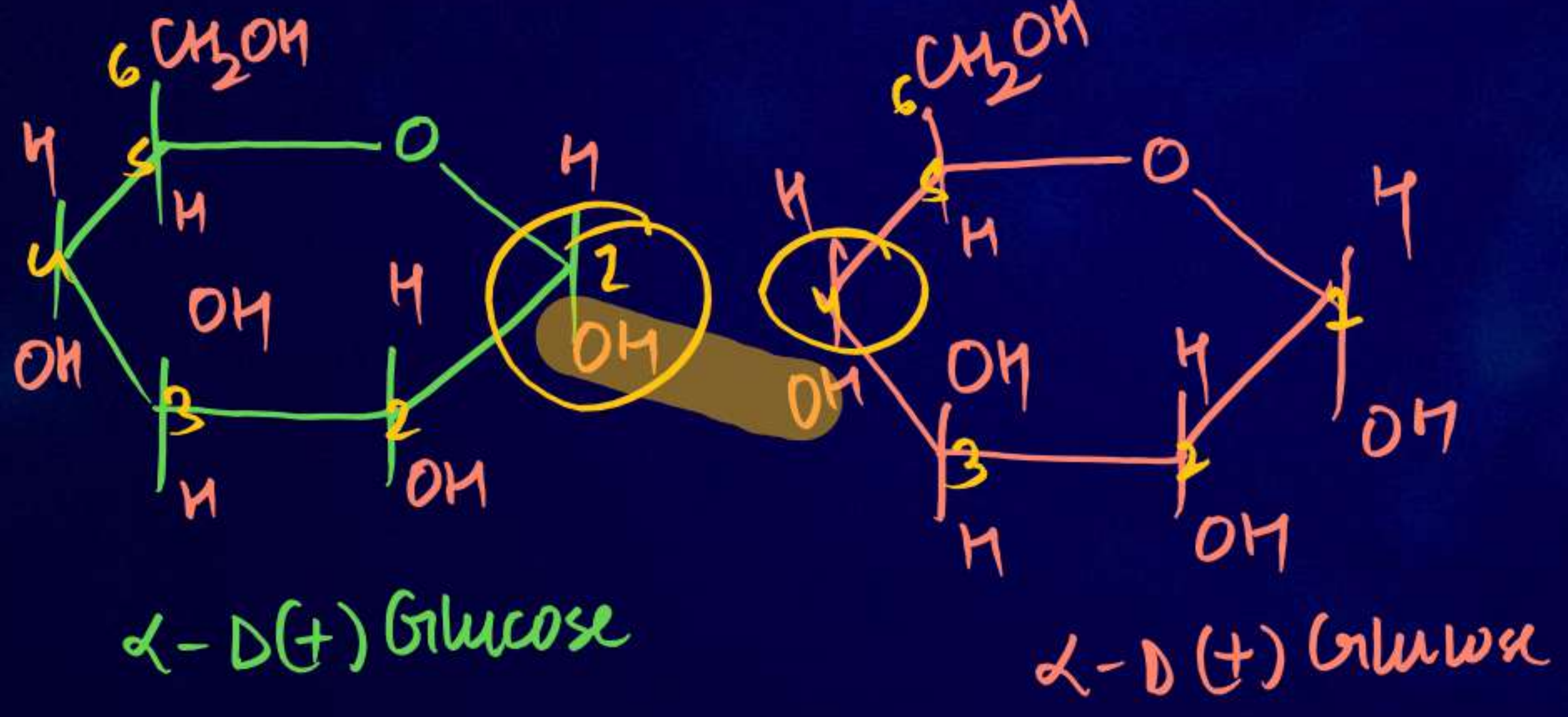
Glucose : dextrorotatory
Fructose : Laevorotatory

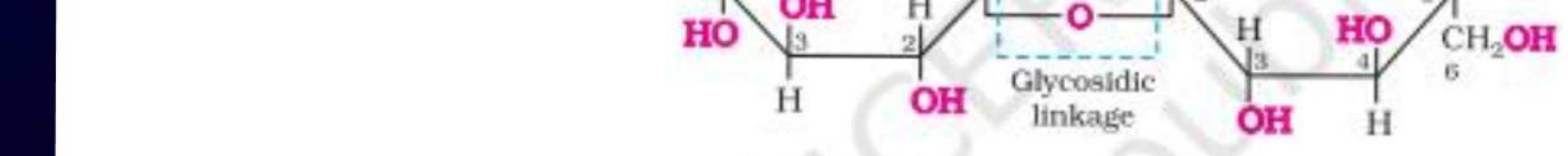
Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. Since the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+ 52.5°), the mixture is laevorotatory. Thus, hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as **invert sugar**.

# MALTOSE

Obtained by $C_1$ of α-D(+) Glucose + $C_4$ of α-D(+) Glucose.





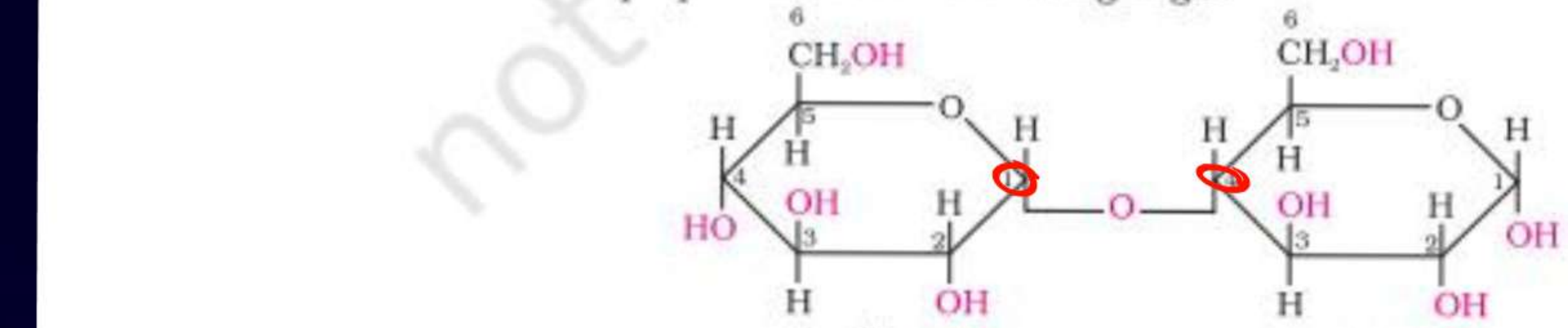



α – D – Glucose β – D – Fructose

**Sucrose**

Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. Since the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+ 52.5°), the mixture is laevorotatory. Thus, hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar.

(ii) *Maltose*: Another disaccharide, maltose is composed of two α-D-glucose units in which C1 of one glucose (I) is linked to C4 of another glucose unit (II). The free aldehyde group can be produced at C1 of second glucose in solution and it shows reducing properties so it is a reducing sugar.



(I) α – D – Glucose (II) α – D – Glucose

**Maltose**



Reprint 2025-26

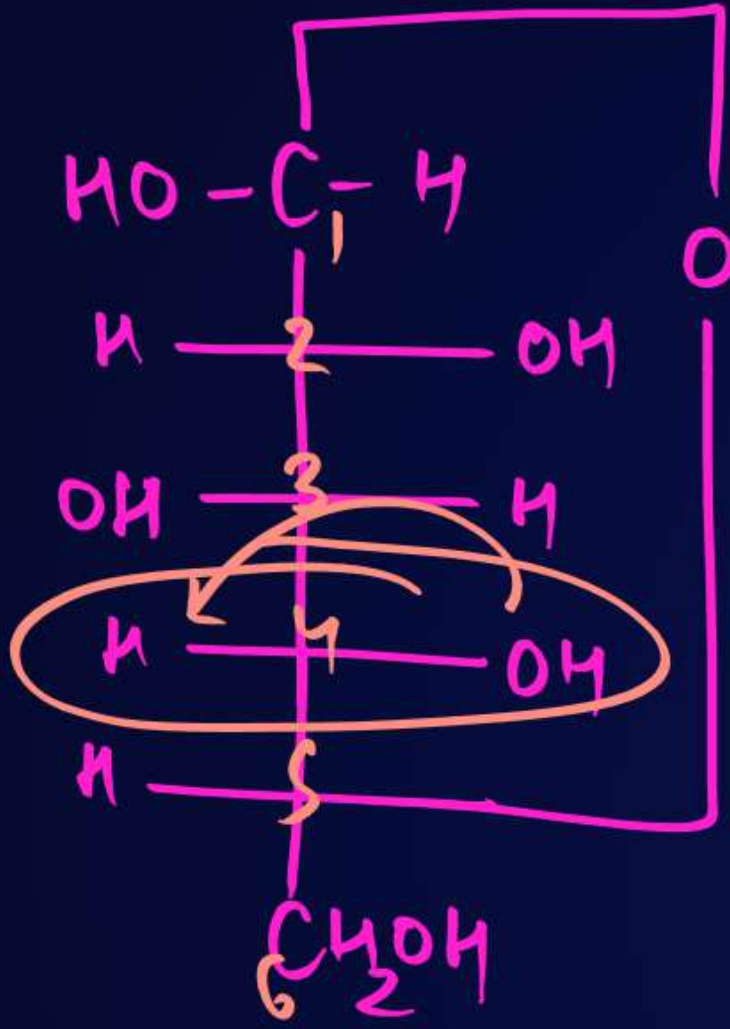
# LACTOSE

↳ Milk sugar

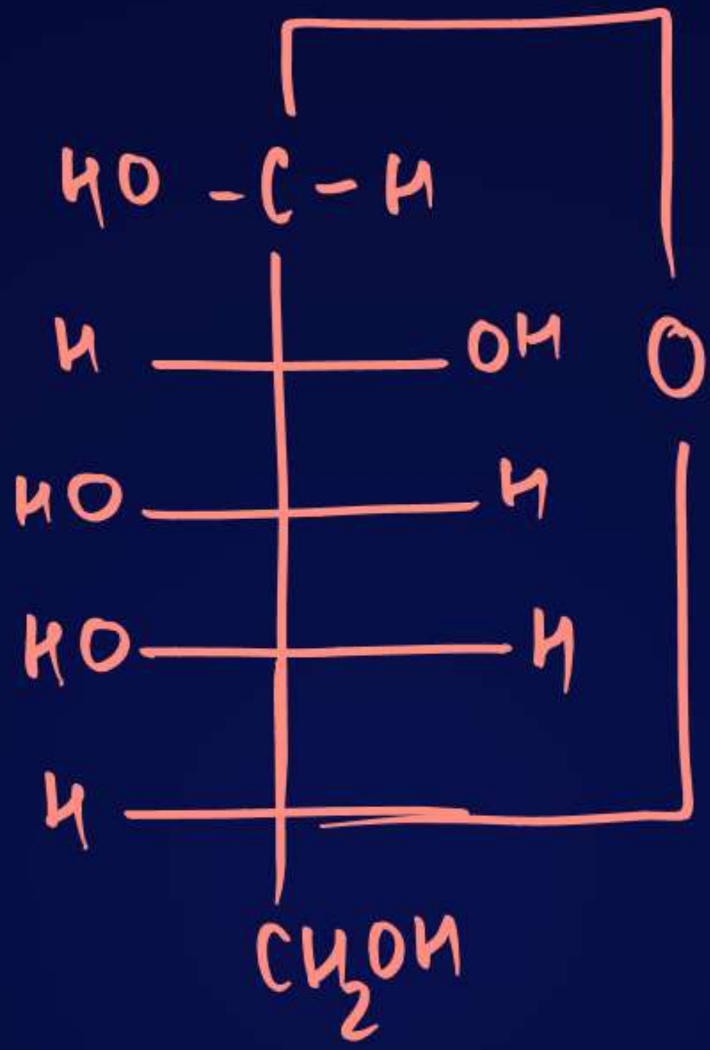
↳ β-D galactose + β-D Glucose
($C_1$) ($C_4$)

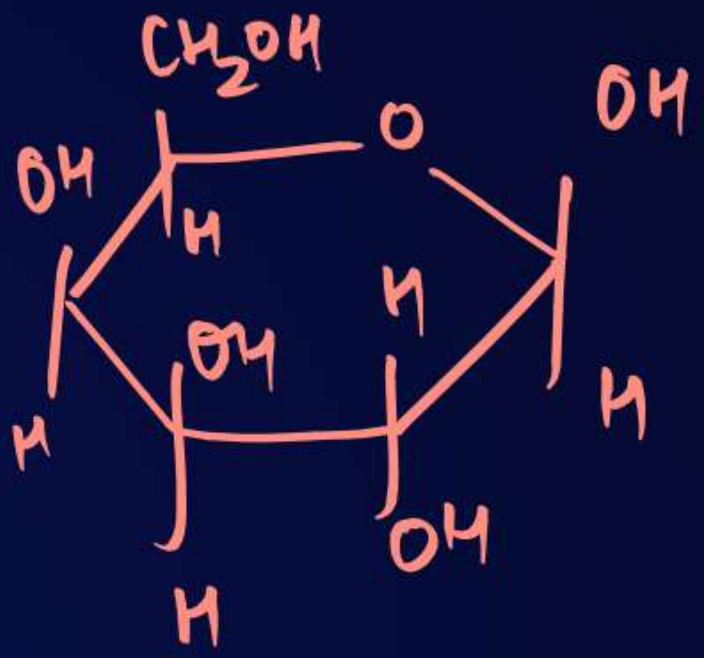
↓

$C_4$ epimer of Glucose



β-D-Glucose



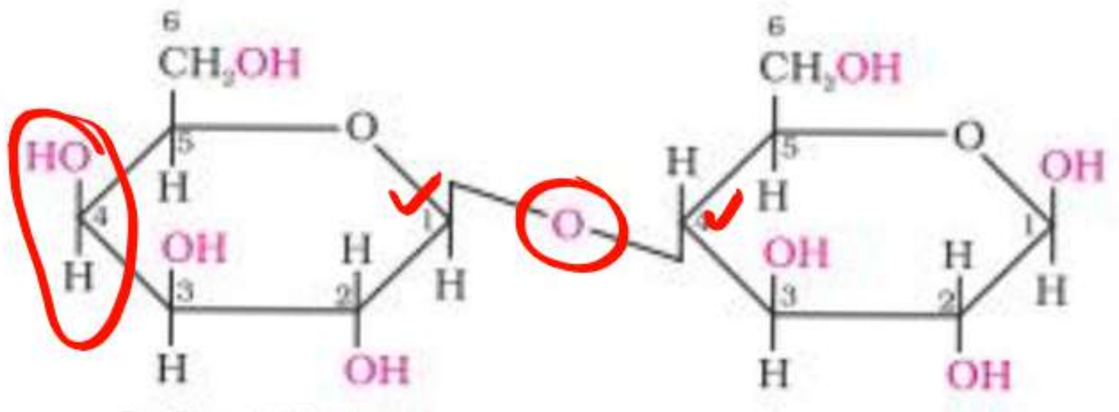


CUET

Amylose
15-20% starch
unbranched

Amylopectin
80%
Highly br.

(iii) *Lactose*: It is more commonly known as milk sugar since this disaccharide is found in milk. It is composed of β-D-galactose and β-D-glucose. The linkage is between C1 of galactose and C4 of glucose. Free aldehyde group may be produced at C-1 of glucose unit, hence it is also a reducing sugar.




**Lactose**

### 10.1.4 Polysaccharides

Difference based que.

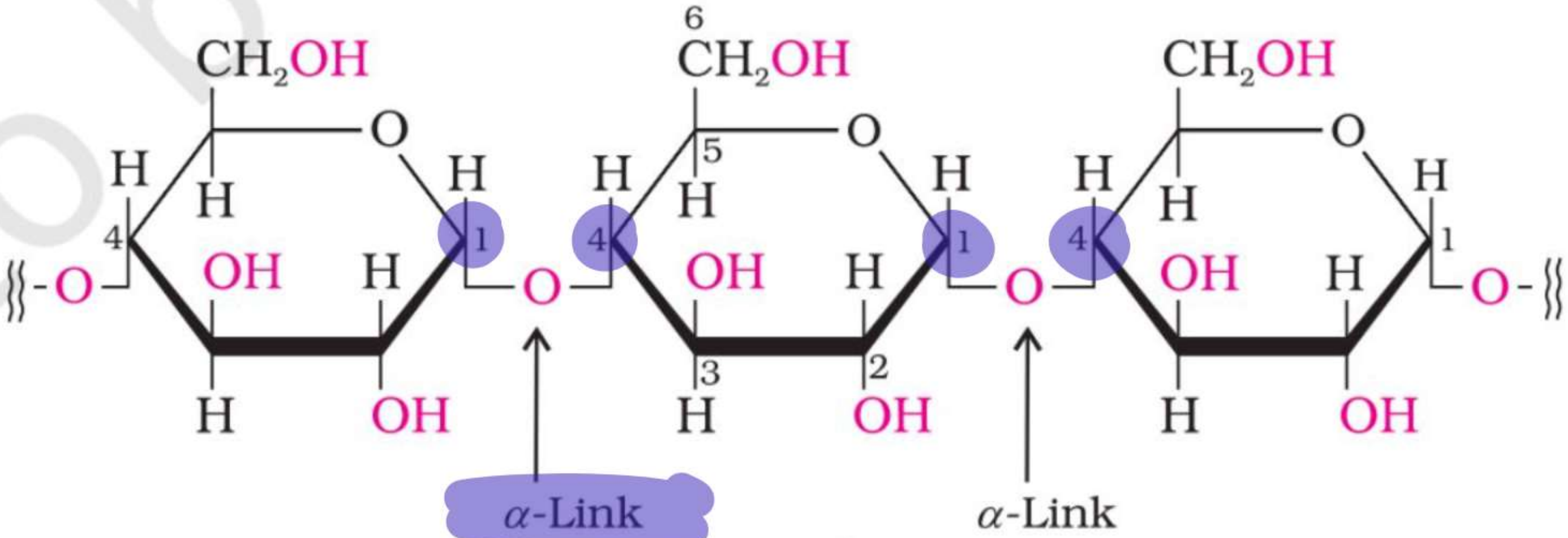
Q

Polysaccharides contain a large number of monosaccharide units joined together by glycosidic linkages. These are the most commonly encountered carbohydrates in nature. They mainly act as the food storage or structural materials.

(i) *Starch*: Starch is the main storage polysaccharide of plants. It is the most important dietary source for human beings. High content of starch is found in cereals, roots, tubers and some vegetables. It is a polymer of α-glucose and consists of two components— Amylose and Amylopectin. Amylose is water soluble component which constitutes about 15-20% of starch. Chemically amylose is a long unbranched chain with 200-1000 α-D-(+)-glucose units held together by C1– C4 glycosidic linkage.

Amylopectin is insoluble in water and constitutes about 80-85% of starch. It is a branched chain polymer of α-D-glucose units in which chain is formed by C1–C4 glycosidic linkage whereas

# STARCH

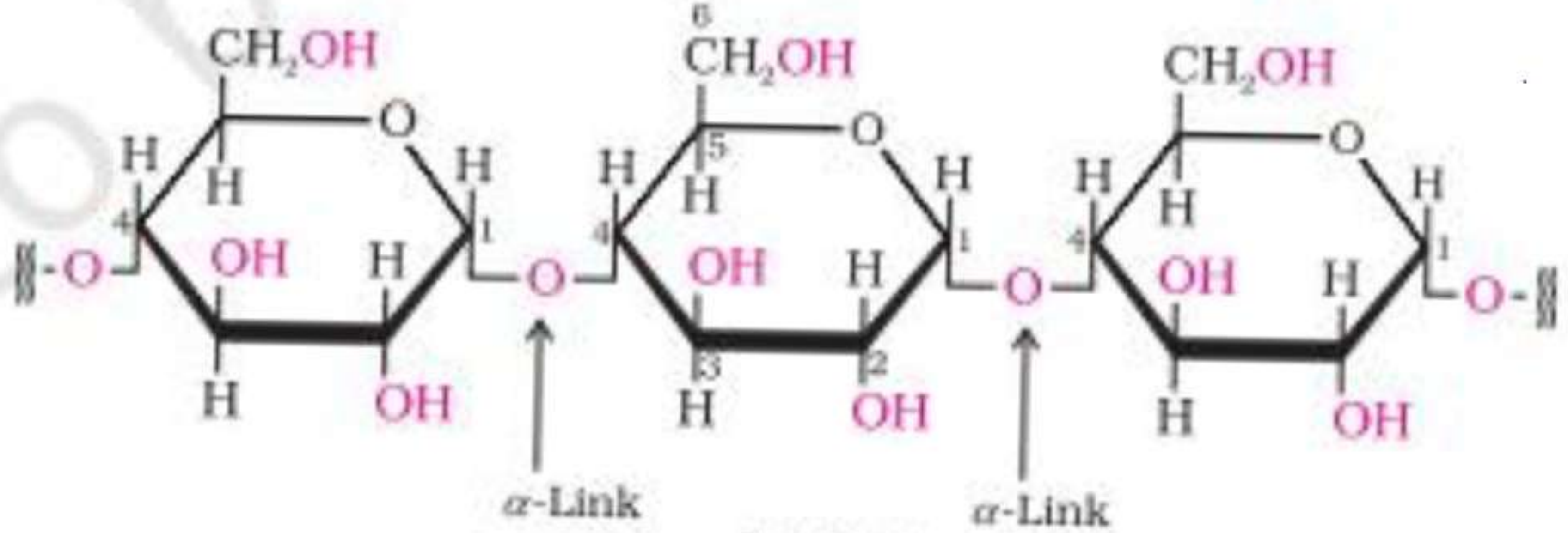



**Amylose**

encountered carbohydrates in nature. They mainly act as the food storage or structural materials.

(i) *Starch*: Starch is the main storage polysaccharide of plants. It is the most important dietary source for human beings. High content of starch is found in cereals, roots, tubers and some vegetables. It is a polymer of α-glucose and consists of two components— Amylose and Amylopectin. Amylose is water soluble component which constitutes about 15-20% of starch. Chemically amylose is a long unbranched chain with 200-1000 α-D-(+)-glucose units held together by C1– C4 glycosidic linkage.

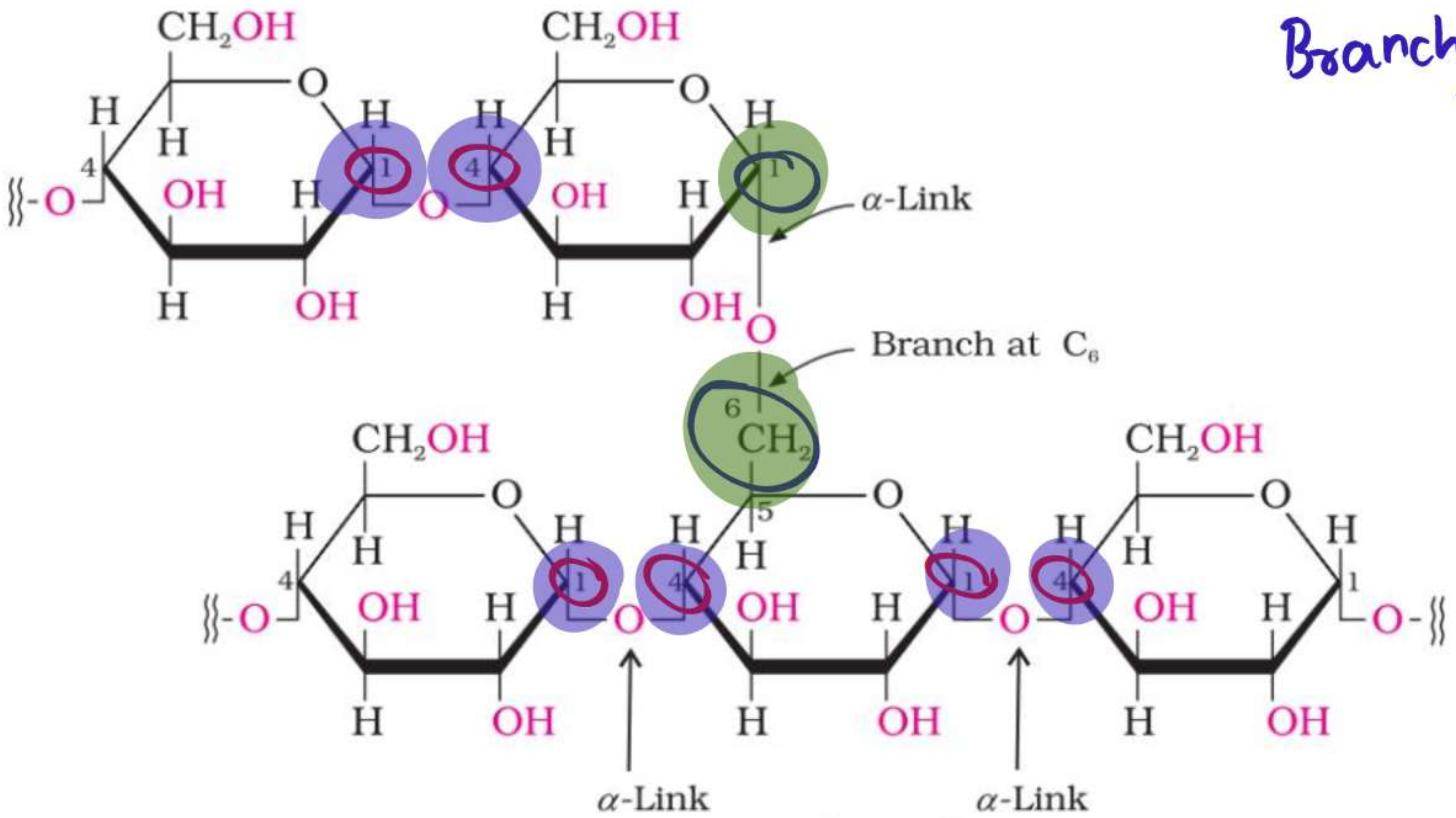
Amylopectin is insoluble in water and constitutes about 80-85% of starch. It is a branched chain polymer of α-D-glucose units in which chain is formed by C1–C4 glycosidic linkage whereas branching occurs by C1–C6 glycosidic linkage.




**Amylose**

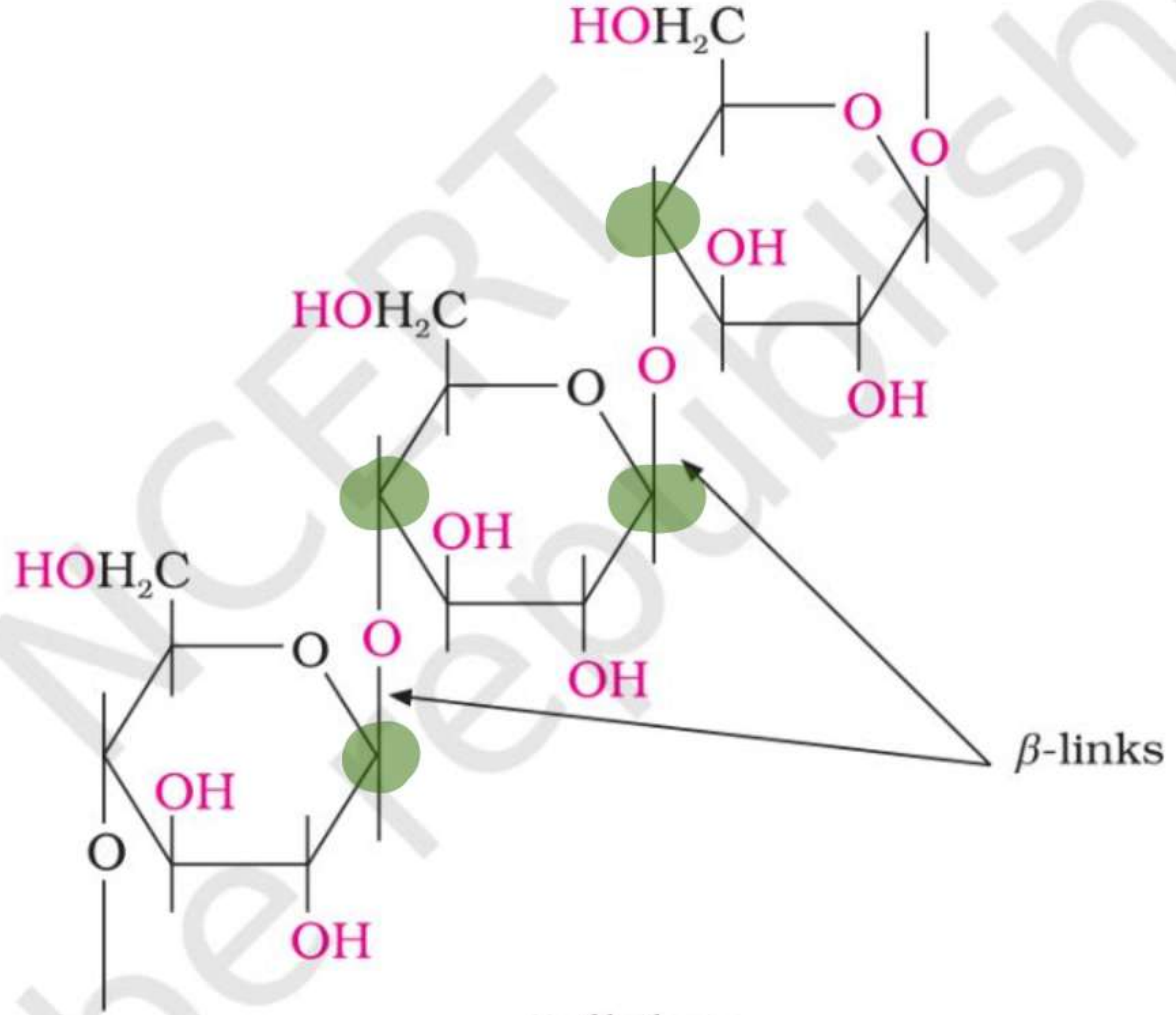
# STARCH

Branching.

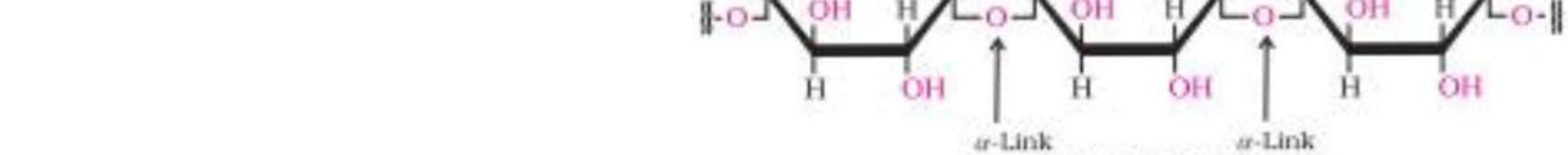



**Amylopectin**

# CELLULOSE

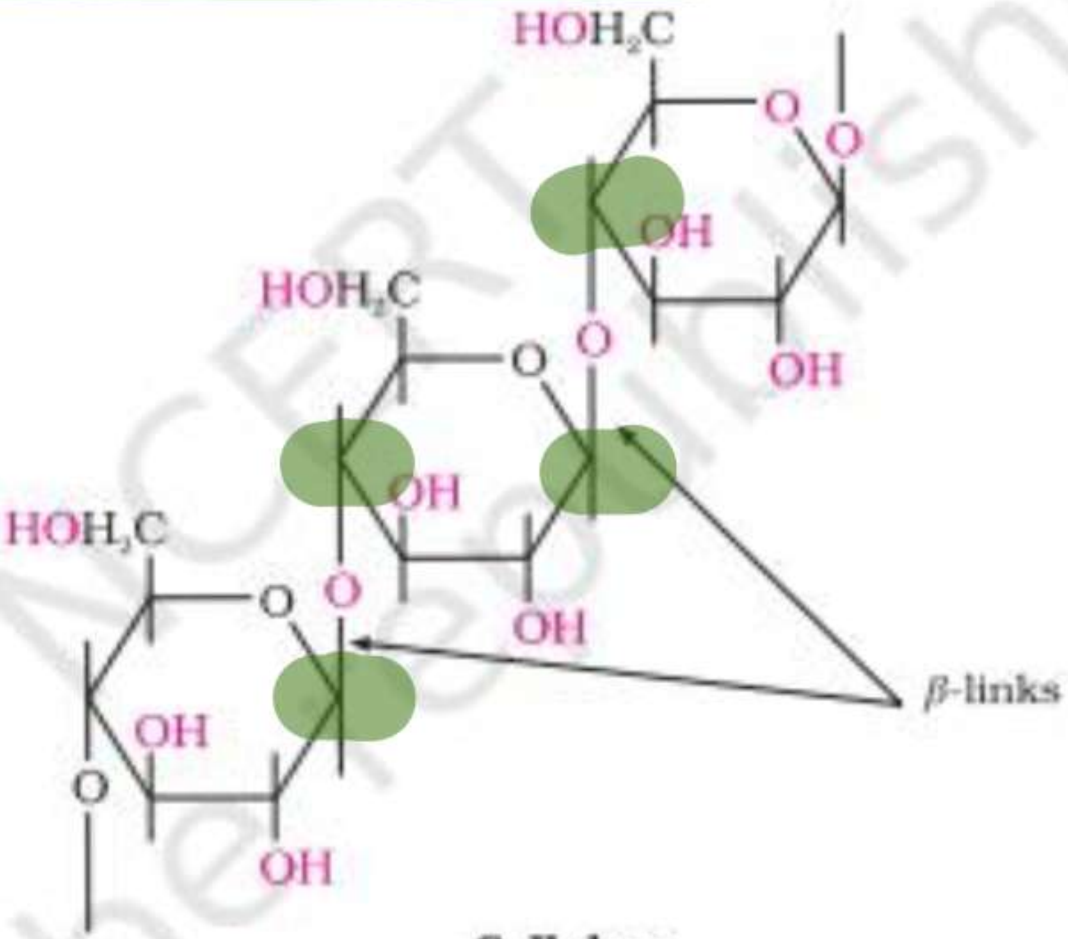



Cellulose




**Amylopectin**

(ii) *Cellulose*: Cellulose occurs exclusively in plants and it is the most abundant organic substance in plant kingdom. It is a predominant constituent of cell wall of plant cells. Cellulose is a straight chain




**Cellulose**

polysaccharide composed only of β-D-glucose units which are joined by glycosidic linkage between C1 of one glucose unit and C4 of the next glucose unit.

(iii) *Glycogen*: The carbohydrates are stored in animal body as glycogen. It is also known as *animal starch* because its structure is similar to amylopectin and is rather more highly branched. It is present in liver, muscles and brain. When the body needs glucose, enzymes break the

# GLYCOGEN

(iii) *Glycogen*: The carbohydrates are stored in animal body as glycogen. It is also known as *animal starch* because its structure is similar to amylopectin and is rather more highly branched. It is present in liver, muscles and brain. When the body needs glucose, enzymes break the glycogen down to glucose. Glycogen is also found in yeast and fungi.

# PROTEINS

SHOURYA MAM
JOIN MY OFFICIAL TELEGRAM CHANNEL
Physics Wallah
@CHEMISTRYBY
SHOURYAMAM

# HOMEWORK

1. COMPLETE NOTES
2. DRAW STRUCTURE AGAIN
3. REVISE NOTES
4. FINISH DHA/DPP

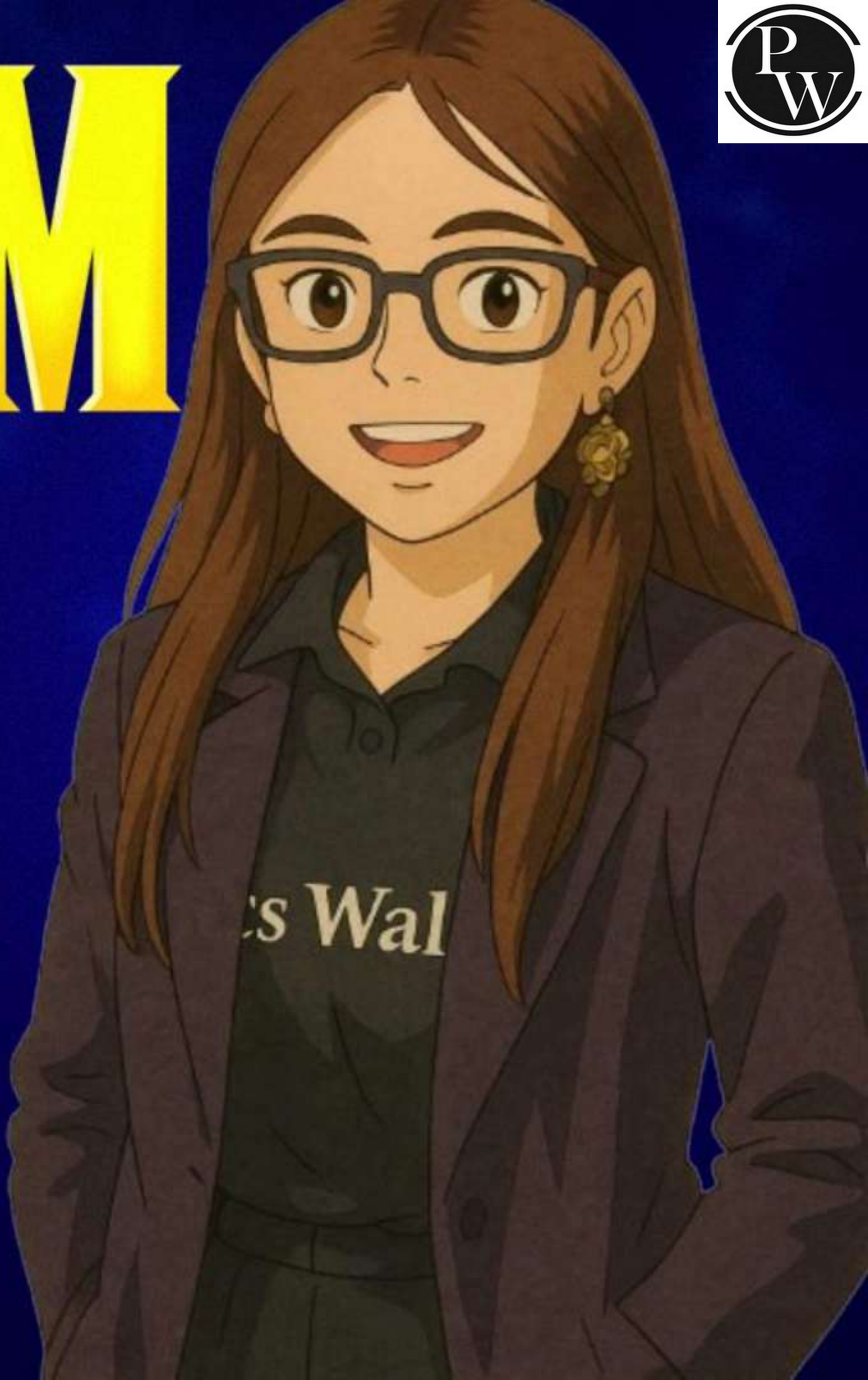
# PARISHRAM

2026

## BIOMOLECULES

CHEMISTRY LECTURE-4

BY – SHOURYA GROVER (SG) MA'AM



# TOPICS TO BE COVERED

1. PROTEIN ✓

2. NUCLEIC ACID ✓

3. MOST IMPORTANT QUE /PYQ'S ✓

4. NCERT READING

# MY SHIMMERING STARS

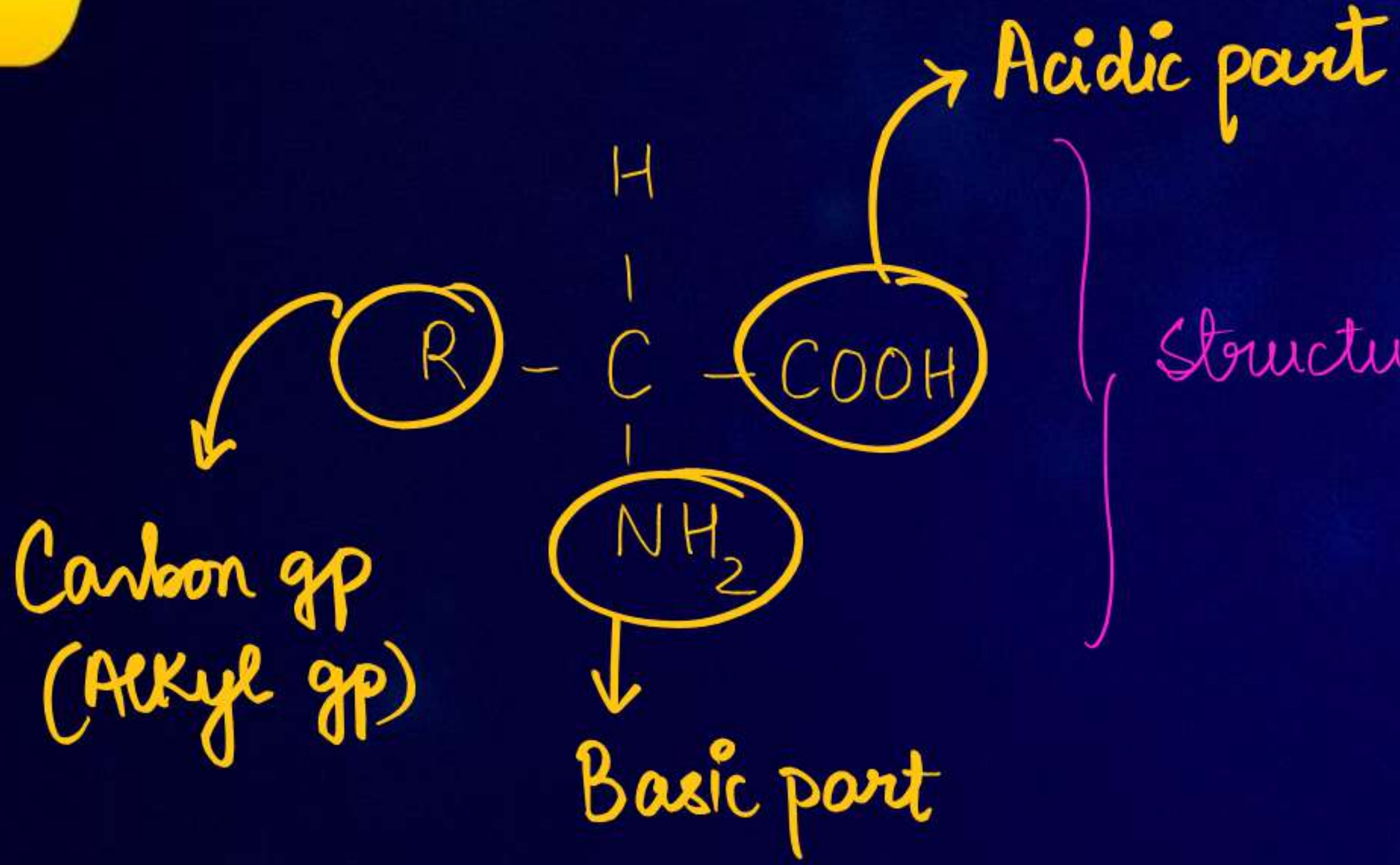
# #SHOURYA'SGALAXY


START

# PROTEINS

- Proteins are the most abundant biomolecules in the living system.
- They are present in every part of the body and form the structural and functional basis of life.
- Main sources: milk, cheese, pulses, peanuts, fish, meat, etc.
- They are essential for growth and maintenance of the body.
- The term 'protein' comes from the Greek word "proteios", meaning primary or of prime importance.
- All proteins are polymers of α-amino acids.

# AMINO ACID




Structure of aminoacid

# CLASSIFICATION OF AMINO ACIDS

| Basis | Essential Amino Acids | Non-essential Amino Acids |
|---|---|---|
| Definition | Those amino acids which **cannot be synthesized** by the human body and **must be obtained from the diet.** | Those amino acids which **can be synthesized** by the human body and **need not be obtained from the diet.** |
| Requirement | **Essential for proper growth and maintenance** of the body. | Required but **body can make them internally.** |
| Examples | Valine, Leucine, Isoleucine, Lysine, Methionine, Threonine, Phenylalanine, Tryptophan, Histidine. | Alanine, Aspartic acid, Glutamic acid, Glycine, Asparagine, Serine, Tyrosine, Proline. |
| Source | Must be taken from **protein-rich food** like milk, eggs, meat, pulses. | Formed inside the body from **intermediates of metabolism.** |

# Classification of Aminoacids

Acidic amino

No of COOH gp > $NH_2$

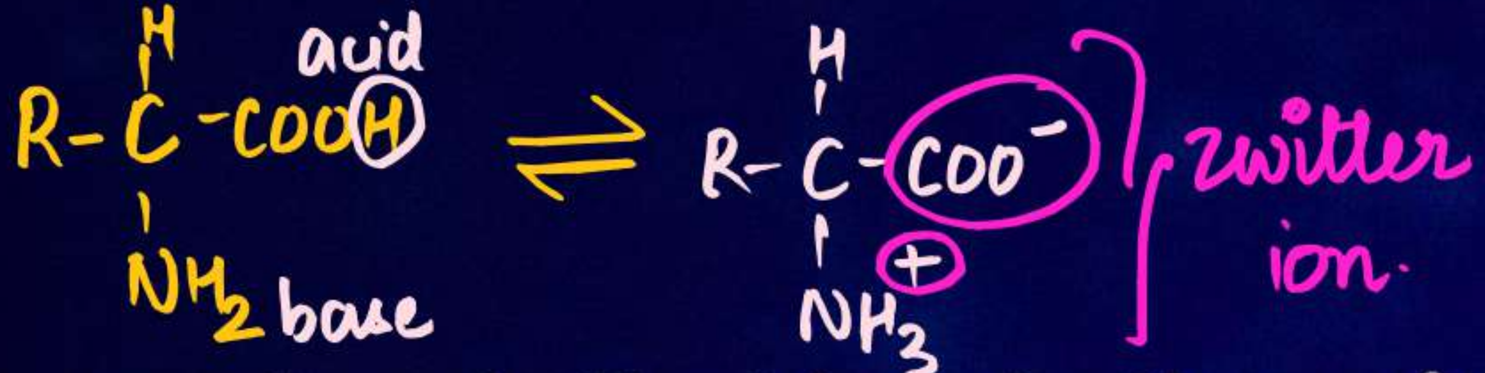
Basic

no. $NH_2$ gp > COOH

Neutral

no. COOH = $NH_2$

# ZWITTER ION




Most Imp Topic

A zwitter ion is a molecule that has both positive and negative charges on different atoms but is overall electrically neutral.

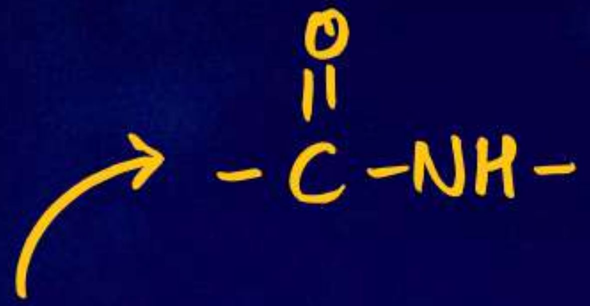
Amino acids contain two functional groups:

$-NH_2$ (amino group) → basic in nature

$-COOH$ (carboxylic acid group) → acidic in nature

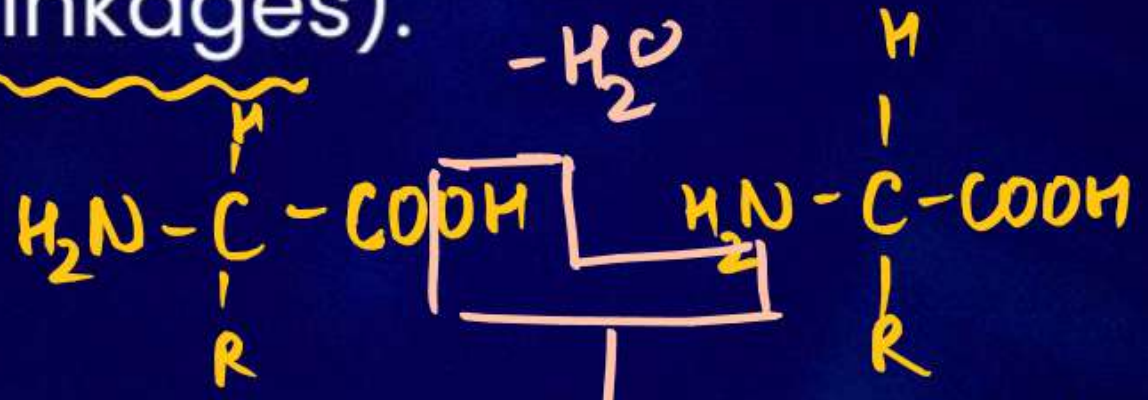
- **Characteristics of Zwitter Ion:**
- Electrically **neutral** overall.
- **Dipolar** in nature (contains both + and – charges).
- Exists mainly at a specific pH called isoelectric point (pI).
- Shows **high melting point** and **solubility in water** due to ionic character.

# FORMATION OF PROTEINS



Que:

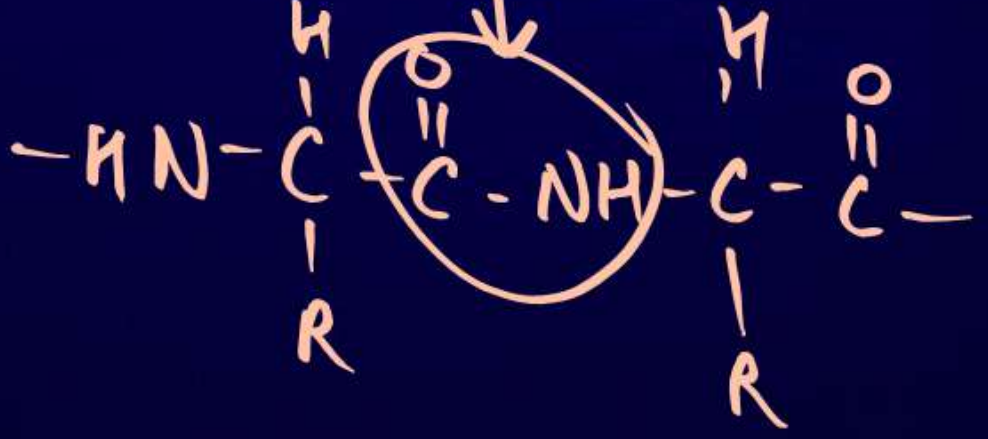
- Proteins are polymers of α-amino acids, linked together by peptide bonds (also called peptide linkages).





### Peptide bond:

- It is a type of amide bond formed between the −COOH group of one amino acid and the $-NH_2$ group of another.
- This reaction eliminates a water molecule ($H_2O$) — a condensation reaction.
- The resulting linkage is −CO−NH−.



$$H_2N-CH_2-COOH + H_2N-\underset{\underset{\displaystyle CH_3}{|}}{CH}-COOH \xrightarrow{-H_2O} H_2N-CH_2-\boxed{CO-NH}-\underset{\underset{\displaystyle CH_3}{|}}{CH}-COOH$$

Peptide linkage

Glycylalanine (Gly-Ala)

# SEQUENCE

## Formation Sequence

2 amino acid

Peptide linkage = $\boxed{\phantom{x}}$

- Two amino acids → **Dipeptide** (e.g., *glycine* + *alanine* → *glycylalanine*)
- **Three amino acids → Tripeptide**
- **Four, five, six... → Tetrapeptide, pentapeptide, hexapeptide**, etc.
- **More than 10 amino acids → Polypeptide**
- **More than 100 amino acids** or molecular mass **> 10,000 u → Protein**

# PROTEINS ON BASIS OF MOLECULAR SHAPE

Difference

| Basis | Fibrous Proteins | Globular Proteins |
|---|---|---|
| 1. Structure | Long, thread-like (fiber-shaped) molecules | Spherical or globular shape |
| 2. Shape | Elongated and rope-like | Compact and folded into spherical form |
| 3. Solubility | Insoluble in water ☆ M.Imp | Generally soluble in water |
| 4. Function | Structural and mechanical support | Functional – involved in metabolic and biological activities |
| 5. Stability | Very stable and resistant to changes in temperature and pH | Less stable and easily affected by temperature or pH |
| 6. Examples Imp | Keratin (hair, wool), Collagen (tendons), Myosin (muscles), Fibroin | Enzymes, Hemoglobin, Insulin, Albumin, Globulin |

peptide Bond

$\underbrace{AA_1 - AA_2}$ $-AA_3 - AA_4$

H bond

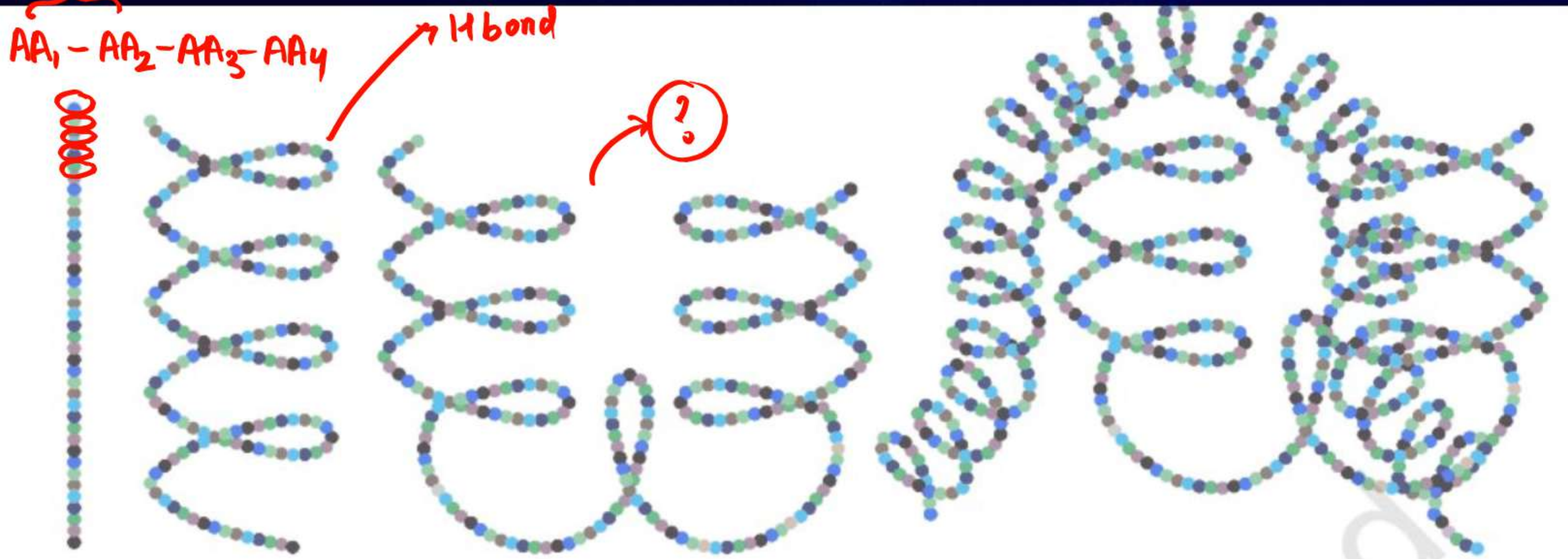



*Fig. 10.3: Diagrammatic representation of protein structure (two sub-units of two types in quaternary structure)*

# STRUCTURE OF PROTEINS

## Primary Structure

- It is the linear sequence of amino acids in a polypeptide chain.
- Amino acids are joined by peptide bonds (–CO–NH–).
- The sequence determines the shape and function of the protein.
- Even a small change in the sequence can change the protein's properties.
- Example: In hemoglobin, replacing glutamic acid with valine causes sickle-cell anemia.

# STRUCTURE OF PROTEINS

## Secondary Structure

- It refers to the regular folding or coiling of the polypeptide chain due to hydrogen bonding between –CO and –NH groups of peptide bonds.
- It gives the protein shape and stability.
- The two most common types are:
- α-Helix (alpha-helix): right-handed coil (like a spring)
- β-Pleated Sheet (beta-sheet): zig-zag folded structure

# STRUCTURE

- Tertiary Structure
- It represents the overall 3D shape of a single polypeptide chain.
- Formed by folding and bending of secondary structures into a compact shape.
- Stabilized by various bonds/interactions:
- Hydrogen bonds
- Disulfide bridges (–S–S–)
- Ionic bonds
- Van der Waals forces
- Hydrophobic interactions
- Determines the biological activity of the protein

# STRUCTURE

Quaternary structure

- Found in proteins made up of more than one polypeptide chain.
- Each chain is called a subunit.
- The arrangement and interaction of these subunits form the quaternary structure.

# STRUCTURE

| Level | Description | Type of Bonds/Forces | Example |
|---|---|---|---|
| **Primary** | Sequence of amino acids | Peptide bonds | Insulin |
| **Secondary** | Regular coiling/folding (α-helix, β-sheet) | Hydrogen bonds | Silk (β-sheet) |
| **Tertiary** | 3D folding of chain | Disulfide, ionic, H-bonds, hydrophobic | Myoglobin |
| **Quaternary** | Association of multiple chains | Same as tertiary (between subunits) | Hemoglobin |

# DENATURATION OF PROTEINS

- Denaturation of proteins is the process in which a native (natural) protein loses its specific structure and biological activity due to the action of heat, chemicals, or pH change.

Theory

- In the **native state**, a protein has a **specific 3D structure** (tertiary or quaternary) that determines its **function**.
- When exposed to **heat, acids, bases, heavy metals, or organic solvents**, the **hydrogen bonds, disulfide bonds, and other interactions** holding the structure together are **broken**.
- The **primary structure** (sequence of amino acids) **remains unchanged**, but the **secondary and tertiary structures are destroyed**.
- As a result, the protein **loses its shape and biological activity**.

- **Example:**

- **Boiling an egg** → The clear egg white (albumin, a protein) becomes opaque and solid.
  → This is due to **denaturation** of albumin by heat.

---

- **Effects of Denaturation:**

1. Loss of biological function (e.g., enzymes stop working).
2. Change in physical properties (solubility, texture, appearance).
3. Irreversible in most cases.

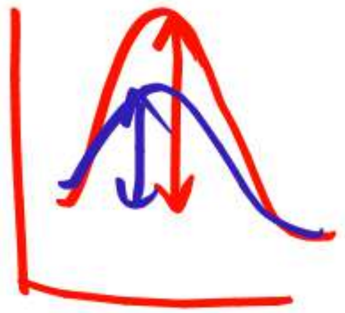
# ENZYMES

# ENZYMES

- Enzymes are biological catalysts — mostly proteins (some are RNA-based) — that speed up biochemical reactions in living organisms without being consumed in the process.

- **Mechanism of Enzyme Action:**

1. **Enzyme + Substrate ⇌ Enzyme–Substrate Complex ⇌ Product + Enzyme**
2. The substrate binds to the **active site** of the enzyme (specific region where reaction occurs).
3. The enzyme lowers the **activation energy** required for the reaction.
4. After the reaction, the **enzyme is released unchanged** and can be reused.



🧠 **Simple representation:**

$$E + S \rightleftharpoons ES \rightarrow E + P$$

E = enzyme, S = substrate, P = product

## Characteristics of Enzymes:

- **Highly specific** (each enzyme acts on one type of substrate)
- **Highly efficient** (increase reaction rate up to $10^6$–$10^{12}$ times)
- **Sensitive to temperature and pH** (usually active around 37°C and pH 5–7)
- **Can be inhibited or activated** by certain substances

---

## Factors Affecting Enzyme Activity:

1. **Temperature** – activity increases with temperature up to an optimum (beyond that enzyme denatures).
2. **pH** – each enzyme has an optimum pH; extremes cause denaturation.
3. **Substrate concentration** – initially increases rate, then levels off when all active sites are occupied.

# VITAMINS

# VITAMINS

- Vitamins are organic compounds required in small quantities for normal growth, metabolism, and proper functioning of the body.

They do not provide energy, but are essential for regulating biochemical reactions (often as coenzymes or cofactors).

# VITAMINS

Most Imp

| Type | Examples | Characteristics |
| --- | --- | --- |
| 1. Fat-Soluble Vitamins | KEDA<br>A, D, E, K | - Soluble in fats & oils, insoluble in water - Stored in liver & adipose tissue |
| 2. Water-Soluble Vitamins | B-complex, C | - Soluble in water - Not stored in body; excess excreted in urine - Must be taken regularly in diet |

# VITAMINS

| Sl. No. | Name of Vitamins | Sources | Deficiency diseases |
|---|---|---|---|
| 1. | Vitamin A | Fish liver oil, carrots, butter and milk | Xerophthalmia (hardening of cornea of eye)<br>Night blindness |
| 2. | Vitamin $B_1$ (Thiamine) | Yeast, milk, green vegetables and cereals | Beri beri (loss of appetite, retarded growth) |
| 3. | Vitamin $B_2$ (Riboflavin) | Milk, eggwhite, liver, kidney | Cheilosis (fissuring at corners of mouth and lips), digestive disorders and burning sensation of the skin. |
| 4. | Vitamin $B_6$ (Pyridoxine) | Yeast, milk, egg yolk, cereals and grams | Convulsions |
| 5. | Vitamin $B_{12}$ | Meat, fish, egg and curd | Pernicious anaemia (RBC deficient in haemoglobin) |
| 6. | Vitamin C (Ascorbic acid) | Citrus fruits, amla and green leafy vegetables | Scurvy (bleeding gums) |
| 7. | Vitamin D | Exposure to sunlight, fish and egg yolk | Rickets (bone deformities in children) and osteomalacia (soft bones and joint pain in adults) |

# VITAMINS

| | | |
|---|---|---|
| 8. Vitamin E | Vegetable oils like wheat germ oil, sunflower oil, etc. | Increased fragility of RBCs and muscular weakness |
| 9. Vitamin K | Green leafy vegetables | Increased blood clotting time |

# NUCLEIC ACID

# NUCLEIC ACID

- Nucleic acids are biopolymers that carry genetic information and control the structure and functions of cells.
- They are the molecules of heredity — responsible for storing and transmitting genetic information from one generation to the next.

# TYPES OF NUCLEIC ACID

- Deoxyribonucleic Acid (DNA) – genetic material in most organisms.
- Ribonucleic Acid (RNA) – helps in protein synthesis and acts as genetic material in some viruses.

## Constituents of Nucleic Acids:

Each nucleic acid is a **polymer of nucleotides.**

→ **Each Nucleotide = 3 Components:**

1. **Nitrogenous base**
2. **Pentose sugar** (5-carbon sugar)
3. **Phosphate group**

🧠 **In DNA:** A, G, C, T

🧠 **In RNA:** A, G, C, U (Uracil replaces Thymine)

## Nucleoside vs. Nucleotide

Imp.

| Component | Composition |
| --- | --- |
| **Nucleoside** | Nitrogenous base + Sugar |
| **Nucleotide** | Nitrogenous base + Sugar + Phosphate group |

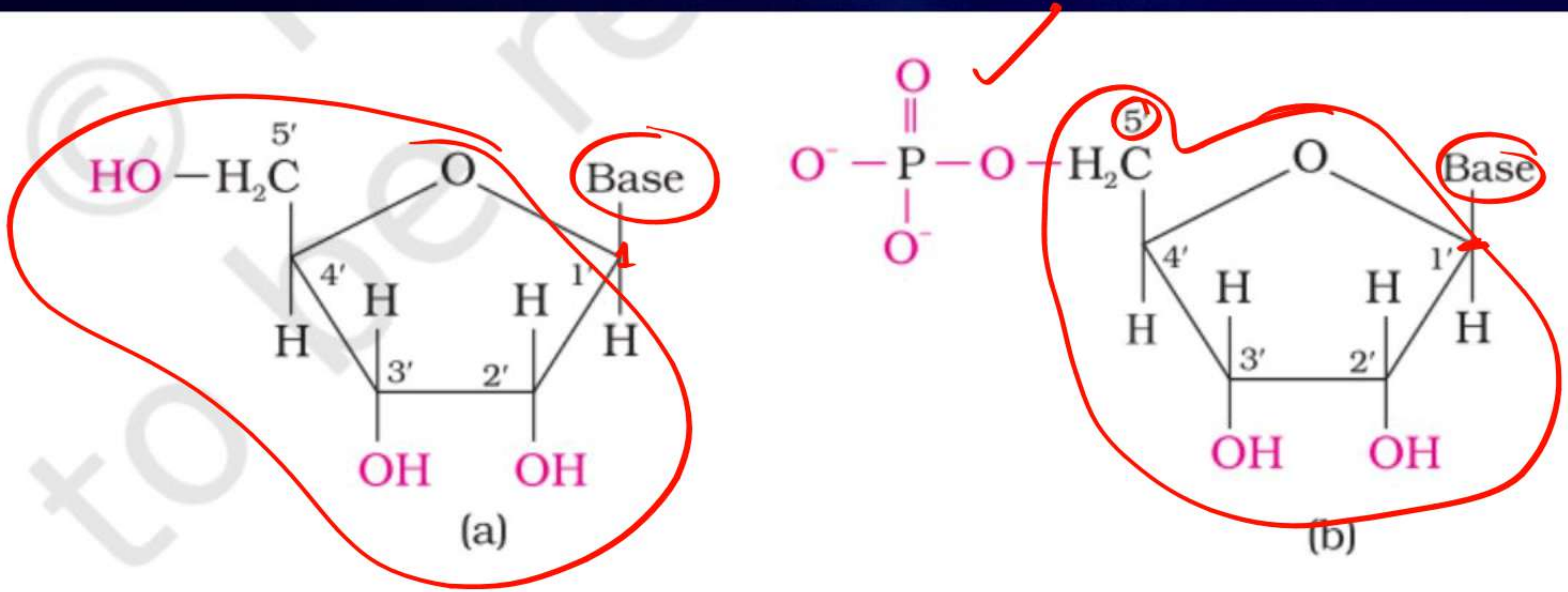



***Fig. 10.5:*** *Structure of (a) a nucleoside and (b) a nucleotide*

# HORMONES

# HORMONES

- Hormones are chemical messengers secreted by endocrine glands in very small amounts, which regulate the physiological activities and metabolism of the body.
- They travel through the bloodstream to specific organs or tissues, called target organs, and control various biological functions like growth, reproduction, metabolism, etc.

# MORE ABOUT HORMONES

- General Characteristics:

1. **Secreted by endocrine glands** (ductless glands).
2. Required in **very small quantities**.
3. **Transported by blood** to target sites.
4. **Regulate biological processes** (growth, metabolism, reproduction, etc.).
5. Each hormone acts on a **specific organ** (target organ).

# MORE ABOUT HORMONES

- Types of Hormones (Based on Chemical Nature):

| Type | Examples | Nature/Remarks |
|---|---|---|
| 1. **Steroid hormones** | Testosterone, Estrogen, Progesterone, Cortisone | Derivatives of cholesterol (lipid-like) |
| 2. **Peptide/Protein hormones** | Insulin, Glucagon, Growth hormone | Made up of amino acids (polypeptides) |
| 3. **Amino acid derivatives** | Adrenaline (Epinephrine), Thyroxine | Derived from amino acids like tyrosine |
| 4. **Polypeptide hormones** | Oxytocin, Vasopressin | Short chains of amino acids |

# QUESTIONS

**What is the basic structural difference between glucose and fructose?**

Solution

Glucose has aldehyde group whereas fructose has keto group.

Write the products obtained after hydrolysis of lactose.

Solution

Lactose on hydrolysis give glucose and galactose.

## What is the difference between Nucleotide and Nucleoside?

Solution

Nucleoside contains ribose or deoxyribose sugar and heterocyclic base, e.g. adenosine, whereas nucleotides contain phosphoric acid residue along with heterocyclic base and pentose sugar, e.g. adenosine triphosphate (ATP).


## What is the basic difference between starch and cellulose?

Solution

Starch is a branched chain polymer of $\alpha$-glucose. It is storage carbohydrate of plants. Cellulose is linear polymer of $\beta$-glucose. It forms cell wall of plants.

**Name a water soluble vitamin which is powerful antioxidant. Give one of its source.**

Solution

Vitamin C is water soluble and antioxidant. It is present in citrus fruits like orange, lemon, amla etc.

**Name the carbohydrate used as storage molecule to store energy in animals.**

Solution

Glycogen (Animal starch).


**Write two differences between RNA and DNA.**

## Solution

| RNA | | DNA | |
|---|---|---|---|
| (i) | It has ribose sugar with A, U, C, G as heterocyclic bases. | (i) | It has deoxyribose sugar along with A, T, C, G as heterocyclic bases. |
| (ii) | It is single helix. | (ii) | It is double helix. |

**What happens when D-glucose is treated with the following? Give the equations in support of your answer (a) HI (b) $HNO_3$ (conc.)**

## Solution

(a) n-hexane is formed, $CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} + HI \rightarrow \underset{\text{n−hexane}}{CH_3-(CH_2)_4-CH_3}$$

(b) $$\underset{\text{Glucose}}{\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} + HI \xrightarrow{\text{conc. } HNO_3} \underset{\text{Saccharic acid}}{\begin{array}{l} COOH \\ | \\ (CHOH)_4 \\ | \\ COOH \end{array}}$$

**Differentiate between the following:**

(i) Amylose and Amylopectin

(ii) Peptide linkage and Glycosidic linkage

(iii) Fibrous proteins and Globular proteins

Solution

(i) **Amylose:** It is a linear chain polymer of a-glucose, water soluble component of starch which constitute 15-20% of starch. It has $C_4$ - $C_1$ linkages.

**Amylopectin:** It is branched chain polymer of a-glucose, water insoluble component, form 80-85% of starch. It has $C_1$ - $C_4$ and $C_1$ - $C_6$ linkages.

(ii) **Peptide bond or peptide linkage:** The bond $\left(\overset{\overset{\displaystyle O}{\|}}{C}-NH\right)$ between two or more amino acids in polypeptides and proteins.

**Glycosidic linkage:** It is oxide linkage between two or more monosaccharide units in Polysaccharides.

(iii) **Fibrous proteins:** Thread like structure, insoluble in water, e.g. keratin (hair, wool, silk), myosin (muscles) etc, have β-pleated structure.

**Globular proteins:** Chains of polypeptidic coil around (α-helix), spherical shape, soluble in water, e.g. insulin, albumin.

Write chemical reactions to show that open structure of D-glucose contains the following:

(i) Straight chain ✓

(ii) Five alcohol groups

(iii) Aldehyde as carbonyl group

## Solution

(i) n-hexane is formed, $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} + HI \rightarrow \underset{\text{n-hexane}}{CH_3-(CH_2)_4-CH_3}$$

(ii)
$$\underset{\text{Glucose}}{\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} + \underset{\substack{\text{Acetic} \\ \text{anhydride}}}{5(CH_3CO)_2O} \rightarrow 5CH_3COOH + \underset{\text{Glucose pentaacetate}}{\begin{array}{l} CHO \\ | \\ (CHOCOCH_3)_4 \\ | \\ CH_2OCOCH_3 \end{array}}$$

(iii) $$\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{D-Glucose} \end{array} + Br_2(aq) \rightarrow \begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose acid} \end{array}$$

Or

$$\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose} \end{array} \xrightarrow{HCN} \begin{array}{l} OH \\ | \\ CH-CN \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose cyanohydrin} \end{array}$$


**Define the following with a suitable example in each:**

**(i) Oligosaccharides**

**(ii) Denaturation of protein**

**(iii) Vitamins**

Solution

(i) **Oligosaccharide:** They give 2 to 10 units of monosaccharide on hydrolysis, e.g. raffinose is trisaccharide of glucose, fructose and galactose.

(ii) **Denaturation of proteins:** On heating or change in pH, hydrogen bonds are disturbed, globules unfold and helix get uncoiled and leads to loss of biological activity, e.g. coagulation of egg white, curdling of milk.

(iii) **Vitamins:** Vitamins are the group of organic compounds which are required in very small amounts for the healthy growth and functioning of animal organism. They cannot be made by organism and so have to be part of our diet. The deficiency of a vitamin can cause a specific disease. Vitamins A, D, E and K are fat-soluble substances, whereas vitamin B complex and vitamin C are water-soluble

Write the reactions involved when D-glucose is treated with the following reagents:

(i) $Br_2$ water

(ii) $H_2N - OH$

(iii) $(CH3CO)_2O$

**Solution**

$$\text{(i)}\quad \begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose} \end{array} + Br_2(aq) \rightarrow \begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose acid} \end{array}$$

$$\text{(ii)}\quad \begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose} \end{array} + \underset{\substack{\text{Hydroxyl} \\ \text{a min e}}}{NH_2OH} \rightarrow \begin{array}{c} CH=NOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose} \\ \text{monoxime} \end{array}$$

$$\text{(iii)}\quad \begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose} \end{array} + \underset{\substack{\text{Acetic} \\ \text{anhydride}}}{5(CH_3CO)_2O} \rightarrow 5CH_3COOH + \begin{array}{c} CHO \\ | \\ (CHOCOCH_3)_4 \\ | \\ CH_2OCOCH_3 \\ \text{Glucose} \\ \text{pentaacetate} \end{array}$$

**What happens when D-glucose reacts with following reagents:**

**(a) $Br_2(aq)$**

**(b) HCN**

**(c) $(CH_2CO)_2O$**

**Solution**

$$\text{(i)}\quad \underset{\text{Glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} + Br_2(aq) \rightarrow \underset{\text{Glucose acid}}{\begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}}$$

$$\text{(ii)}\quad \underset{\text{D-Glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} + Br_2(aq) \rightarrow \underset{\text{Glucose acid}}{\begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}}$$

$$\text{Or}\quad \underset{\text{Glucose}}{\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}} \xrightarrow{HCN} \begin{array}{c} OH \\ | \\ CH-CN \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array}$$

(iii)

$$\begin{array}{l} \text{CHO} \\ | \\ (\text{CHOH})_4 \\ | \\ \text{CH}_2\text{OH} \\ \text{Glucose} \end{array} + \underset{\substack{\text{Acetic} \\ \text{anhydride}}}{5(\text{CH}_3\text{CO})_2\text{O}} \rightarrow 5\text{CH}_3\text{COOH} + \begin{array}{l} \text{CHO} \\ | \\ (\text{CHOCOCH}_3)_4 \\ | \\ \text{CH}_2\text{OCOCH}_3 \\ \text{Glucose} \\ \text{pentaacetate} \end{array}$$

(a) Write the products when D-glucose reacts with $Br_2(aq)$.

(b) What type of bonding provides stability to α-helix structure of protein?

H-bond

(c) Name the vitamin whose deficiency cause pernicious anaemia.

## Solution

(a)
$$\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose} \end{array} + Br_2(aq) \rightarrow \begin{array}{c} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \\ \text{Glucose acid} \end{array}$$

(b) Intra-molecular H-bonding stabilise a-helix.

(c) Vitamin-$B_{12}$

**Define the following terms:**

**(a) Invert sugar**

**(b) Native protein**

**(c) Nucleotide**

Solution

(a) Invert sugar: It is a mixture containing equal amount of glucose and fructose.
(b) Native protein: The protein in its natural form having peptide bond is called native protein.
(c) Nucleotide:

Define the following terms with a suitable example of each:

(a) Anomers

(b) Essential amino acid

(c) Denaturation of proteins

Solution

(a) **Anomers:** Those compounds which differ in orientation of -OH group on C-1 carbon atom are called anomers, e.g. a-glucose and ß-glucose.

(b) **Essential amino acids:** Those amino acids which are not synthesised by our body and must be a part of our diet are called essential amino acids. For Example-Valine. leucine etc.

Define the following terms with a suitable example of each:

(a) Tertiary structure of proteins

(b) Essential amino acid

(c) Disaccharide

Solution

(a) It represents overall folding of polypeptide chain involving H-bond, ionic bond, disulfide linkages, e.g. insulin.

(c) **Disaccharide:** Those carbohydrates, which on hydrolysis give two moles of monosaccharides, e.g., $C_{12}H_{22}O_{11}$ (sucrase), maltose, lactose


(a) What is the difference between native protein and denatured protein?

(b) Which one of the following is disaccharide: Glucose, Lactose, Amylose, Fructose.

(c) Write down the vitamin which is responsible for coagulation of blood.

## Solution

(a) **Native protein** are found in biological system with unique 3D structure and biological activity is seen, while denatured protein has no biological activity and random coil structure.

(b) Lactose

(c) Vitamin-K.


(a) Differentiate between the following (Give one difference for each):

(i) Native proteins and denatured proteins

(ii) α-helix and β-pleated structure of proteins.

(b) Why vitamin-C cannot be stored in our body?

**Solution**

(a) (ii) $\alpha$-helix: They are polypeptide chains stabilises by intra-molecular H-bonds.

$\alpha$-pleated: They are stabilises by inter-molecular H-bonding.

(b) It is soluble in water, therefore, excreted by body.


**Define the following with an example of each:**

**(a) Polysaccharides**

**(b) Denatured protein**

**(c) Essential amino acids**

Solution

(a) Those carbohydrate which on hydrolysis give large number of monosaccharides are called polysaccharide e.g. starch.

(b) The protein whose secondary and tertiary structure is ruptured but primary structure remains the same is called denatured proein e.g. Hard boiled egg contains denatured protein.


(a) Write the product when D-glucose reacts with conc. $HNO_3$.

(b) Amino acids show amphoteric behaviour. Why?

(c) Write one difference between a-helix and ß-pleated structures of proteins.

Solution

(b) Those amino acids which have both acidic (–COOH) as well as basic (–$NH_2$) groups in their structure due to which they react with both acids as well as bases, i.e. show amphoteric behavior. They form zwitter ion.


**Explain the following:**

(i) Amino acids behave like salts rather than simple amines or carboxylic acids.

(ii) The two strands of DNA are complementary to each other.

(iii) Reaction of glucose that indicates that the carbonyl group is present as an aldehydic group in the open structure of glucose.

Solution

(i) It is because these exist as Zwitter ion e.g.,

They form internal salt.

(ii) Since there is specific H–bonding between heterocyclic bases. Adenine (A) can form H-bond with T, Thymine (T) with A, (Cytocine) C can form H-bond with G(Guanine) and vice versa. Hence, two strands of DNA are complementary not identical.


**(a) Name the type of bonding which stabilises $\alpha$-helix in proteins.**
**(b) Name the products of hydrolysis of lactose.**

Solution

(a) Intra-molecular H-bonding.

Give reason:

(a) Vitamin-C cannot be stored in our body.

(b) Which of the following is polysaccharide: starch, maltose, glucose, fructose.

Solution

(b) Starch


(a) What type of linkage is present in disaccharides?
(b) Write one source and deficiency disease of vitamin $B_{12}$
(c) Write the difference between DNA and RNA.

**Solution**

(a) Glycosidic linkage is present in disaccharides.

(b) Vitamin $B_{12}$ is present in animal tissues eggs, curd, almonds. It is deficiency disease is Pernicious anaemia (RBC deficiency in haemoglobin).

SHOURYA MAM
JOIN MY OFFICIAL TELEGRAM CHANNEL
@CHEMISTRYBY
SHOURYAMAM
Physics Wallah

Thank You