

Chapter 10 · Biomolecules

CBSE Class 12 Chemistry (043) · Organic · Unit 10 = 7 marks · Ultimate Revision Sheet

60-SECOND RECALL

Reducing sugars	All monosaccharides + maltose, lactose · sucrose is NOT
Sucrose	Glucose + fructose, α-1,2 glycosidic · invert sugar on hydrolysis
Starch	Amylose (linear) + amylopectin (branched)
Protein bond	Peptide bond, $-\text{CO}-\text{NH}-$
Essential amino acids	Cannot be synthesised by the body
Denaturation	2° and 3° structure destroyed; 1° stays intact
Vitamin C, B	Water soluble · A, D, E, K fat soluble
DNA vs RNA	DNA: deoxyribose, T , double helix · RNA: ribose, U , single strand

1. Carbohydrates

CLASSIFICATION **Monosaccharides** (glucose, fructose) cannot be hydrolysed further. **Disaccharides** (sucrose, maltose, lactose) give two units. **Polysaccharides** (starch, cellulose, glycogen) give many. **Reducing sugars** reduce Tollens' and Fehling's: **all monosaccharides, plus maltose and lactose**. **Sucrose is non-reducing**, because both anomeric carbons are locked in the glycosidic link.

GLUCOSE — structure evidence asked directly **Open chain:** $\text{CHO}-(\text{CHOH})_4-\text{CH}_2\text{OH}$, an **aldohexose**, D-(+)-glucose.

Reaction	What it proves
HI, long heating $\rightarrow$ n-hexane	Straight chain of six carbons
Tollens'/Fehling's positive; HCN $\rightarrow$ cyanohydrin	Contains a $-\text{CHO}$ group
Acetic anhydride $\rightarrow$ penta-acetate	Five $-\text{OH}$ groups
Br_2 water $\rightarrow$ gluconic acid	$-\text{CHO}$ oxidises to $-\text{COOH}$
$\text{HNO}_3 \rightarrow$ saccharic acid	Primary $-\text{OH}$ also oxidises

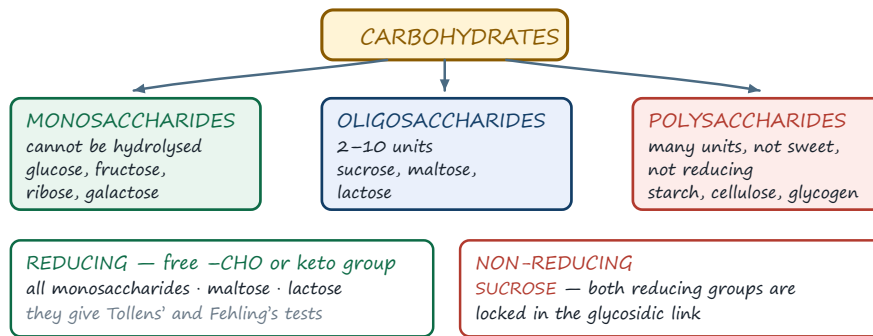
Two facts the open chain could NOT explain: glucose does not give the **2,4-DNP / NaHSO_3** tests properly, and it shows **mutarotation** — which is why the **cyclic pyranose** structure with α and β anomers was proposed.

THE POLYSACCHARIDES **Starch** = **amylose** (linear, α -1,4) + **amylopectin** (branched, α -1,4 and α -1,6). Storage form in plants.

Cellulose = linear chains of β -D-glucose joined **β -1,4**. Humans lack the enzyme for β links, which is why we cannot digest it.

Glycogen = "animal starch", more highly branched than amylopectin; stored in liver and muscle.

Carbohydrates — classify by how many units, then by whether it reduces



Sucrose → glucose + fructose on hydrolysis. The rotation flips from $+66^\circ$ to -20° , which is why it is called **INVERT SUGAR** — and both products ARE reducing, even though sucrose is not.

Protein traps: denaturation destroys 2° and 3° structure only, the primary sequence survives.

Starch and cellulose differ in **one bond**: starch is α -glycosidic (we digest it), cellulose is β -glycosidic (we cannot). That single letter is the whole answer.

2. Proteins

AMINO ACIDS Contain both $-NH_2$ and $-COOH$. In solution they exist as the **zwitterion** $^+H_3N-CHR-COO^-$, which is why they have **high melting points** and behave like ionic solids. At the **isoelectric point** the amino acid has no net charge and does not migrate in an electric field.

Essential amino acids must come from the diet (valine, leucine, lysine...); **non-essential** ones the body makes itself.

THE FOUR LEVELS OF STRUCTURE

- Primary**: the sequence of amino acids joined by **peptide bonds**.
- Secondary**: local folding into an α -helix or β -pleated sheet, held by **hydrogen bonds**.
- Tertiary**: overall three-dimensional folding, held by disulphide bridges, hydrogen bonds, and hydrophobic interactions.
- Quaternary**: how two or more polypeptide chains pack together (e.g. haemoglobin).

DENATURATION — asked every year Heat, acid or heavy metals destroy the **secondary and tertiary** structure, so the protein loses its biological activity. The **primary structure remains intact**. **Everyday examples**: boiling an egg (albumin coagulates), curdling of milk.

ENZYMES Enzymes are **biological catalysts**, almost all **globular proteins**. They are **highly specific** — one enzyme, one reaction — and work by **lowering the activation energy**. Names usually end in **-ase** (maltase, urease).

3. Vitamins and Nucleic Acids

VITAMINS — the deficiency table

Vitamin	Solubility	Deficiency disease
A	Fat	Xerophthalmia, night blindness
B₁	Water	Beri beri

B₆	Water	Convulsions
B₁₂	Water	Pernicious anaemia
C	Water	Scurvy
D	Fat	Rickets and osteomalacia
E	Fat	Sterility, muscular weakness
K	Fat	Increased blood clotting time

Water soluble: B and C — must be supplied regularly since they are excreted. Fat soluble: A, D, E, K — stored in liver and fatty tissue.

NUCLEIC ACIDS A **nucleoside** = sugar + base. A **nucleotide** = sugar + base + **phosphate**. Nucleotides join through **phosphodiester** linkages.

Basis	DNA	RNA
Sugar	2-deoxy-D-ribose	D-ribose
Bases	A, G, C, T	A, G, C, U
Strands	Double helix	Usually single
Function	Stores genetic information; replication	Protein synthesis

Base pairing: A–T (two H bonds) and G–C (three H bonds) — the two strands are complementary, which is the basis of replication.

4. Question Triggers what the wording wants

If the question says...	The answer is...
"does not reduce Fehling's solution"	Sucrose — non-reducing
"glucose gives penta-acetate"	It has five –OH groups
"why cyclic structure was proposed"	Mutarotation ; fails some –CHO tests
"boiling an egg / curdling milk"	Denaturation
"which structure survives denaturation"	Primary
"deficiency causes scurvy / rickets"	Vitamin C / Vitamin D
"base present in RNA but not DNA"	Uracil
"linkage in cellulose"	β-1,4 glycosidic

MOST-ASKED BOARD QUESTIONS

1. [3M] Describe the **structure of glucose** and the reactions that establish it.
2. [3M] Explain the **four levels of protein structure** and what denaturation destroys.
3. [3M] Compare **DNA and RNA** on sugar, bases, structure and function.
4. [2M] What are **essential and non-essential amino acids**? Give one example of each.
5. [2M] Why is sucrose called **invert sugar** and why is it non-reducing?
6. [1M] Name the vitamin whose deficiency causes **increased blood clotting time**. → **Vitamin K**

THE HABIT THAT SCORES — This chapter is almost pure recall, so it is the cheapest 7 marks in the paper. Learn the four small tables — reducing sugars, protein structure levels, vitamin deficiencies, DNA vs RNA — and you have nearly the whole unit.