ChapterNotes

chapternotes.in · free NEET & JEE prep

CHAPTER NOTES

Biomolecules Class 12 Notes — CBSE Chemistry Chapter 14

✓ Chapter-wise notes & important questions

✓ Free gamified practice app — streaks, levels, revision

✓ Free mock & prediction papers with answer keys

Source: https://chapternotes.in/cbse/class-12-chemistry/biomolecules-class-12-notes/

Scan to practice this chapter free in the app

Biomolecules Class 12 Notes — CBSE Chemistry Chapter 14

Chapter 14 — **Biomolecules** — is where chemistry meets biology! This chapter covers the four major classes of biomolecules: carbohydrates, proteins, nucleic acids, and vitamins. It carries **4-6 marks** in Board exams and is mostly factual. Focus on the structures of glucose, classification of carbohydrates, and amino acid structures.

Key Concepts

Carbohydrates

General formula: $C_n(H_2O)_n$ — "hydrates of carbon"

Classification

Type	Hydrolysis	Examples
Monosaccharides	Cannot be hydrolysed further	Glucose ($C_6H_{12}O_6$), Fructose, Ribose, Galactose
Disaccharides	Give 2 monosaccharides	Sucrose (Glu + Fru), Maltose (Glu + Glu), Lactose (Glu + Gal)
Polysaccharides	Give many monosaccharides	Starch, Cellulose, Glycogen

Glucose — Structure Determination

Molecular formula: $C_6H_{12}O_6$

Evidence for open-chain structure (aldohexose):

1. Reacts with HI → n-hexane (6 C chain)
2. Reacts with NH_2OH → oxime (has C=O)
3. Reacts with HCN → cyanohydrin (confirms aldehyde)
4. Acetylation with acetic anhydride → pentaacetate (5 –OH groups)
5. Mild oxidation with Br_2/H_2O → gluconic acid (confirms –CHO)

Cyclic structure (Haworth):

Glucose exists as cyclic hemiacetal (C1 aldehyde + C5 hydroxyl form a ring)

Two anomers: α-D-glucose (–OH at C1 below ring) and β-D-glucose (–OH at C1 above ring)

Mutarotation: Change in optical rotation when α or β form is dissolved in water (equilibrium mixture forms)

Reducing vs Non-reducing Sugars

Reducing Sugars	Non-reducing Sugars
Have free aldehyde/ketone group (or hemiacetal)	No free anomeric carbon — both involved in glycosidic bond
Give positive Tollen's/Fehling's test	No reaction with Tollen's/Fehling's
Glucose, Fructose, Maltose, Lactose	**Sucrose** (the only common non-reducing disaccharide)

Why sucrose is non-reducing: In sucrose, the glycosidic bond is between C1 of glucose and C2 of fructose — BOTH anomeric carbons are involved. So neither can open up to give the free aldehyde/ketone → non-reducing.

Polysaccharides

Polysaccharide	Monomer	Linkage	Function
Starch (Amylose)	α-D-glucose	α-1,4 glycosidic	Energy storage (plants)
Starch (Amylopectin)	α-D-glucose	α-1,4 + α-1,6 (branching)	Energy storage (plants)
Cellulose	β-D-glucose	β-1,4 glycosidic	Structural (plant cell walls)
Glycogen	α-D-glucose	α-1,4 + α-1,6 (more branching)	Energy storage (animals)

Amino Acids and Proteins

Amino Acids

General structure: $H_2N–CHR–COOH$ (α-amino acids). All except glycine are optically active.

In solution, they exist as **zwitterions**: $^{+}H_3N–CHR–COO^{-}$ (internal salt)

Isoelectric point (pI): pH at which amino acid exists as zwitterion with no net charge.

Essential Amino Acids

10 amino acids that the body cannot synthesise — must be obtained from diet:

Valine, Leucine, Isoleucine, Phenylalanine, Tryptophan, Threonine, Methionine, Lysine, Arginine, Histidine

> **Memory Aid (PVT TIM HALL):** Phenylalanine, Valine, Threonine, Tryptophan, Isoleucine, Methionine, Histidine, Arginine, Leucine, Lysine

Structure of Proteins

Level	Description	Forces
Primary	Linear sequence of amino acids	Peptide bonds (–CO–NH–)
Secondary	α-helix or β-pleated sheet	Hydrogen bonds between C=O and N–H
Tertiary	3D folding of polypeptide	H-bonds, disulphide bridges, ionic, hydrophobic
Quaternary	Multiple polypeptide chains together	Same as tertiary

Denaturation

Loss of 2°, 3°, 4° structure (primary remains intact). Caused by heat, pH change, organic solvents. Example: boiling an egg — albumin denatures.

Enzymes

Biological catalysts (proteins). Highly specific — lock and key model.

- **Optimum temperature:** 25-37°C (human enzymes)
- **Optimum pH:** varies (pepsin = 2, trypsin = 8)
- **Naming:** usually end in “-ase” (lipase, urease, maltase)

Vitamins

Vitamin	Chemical Name	Deficiency Disease	Source
A	Retinol	Night blindness, Xerophthalmia	Carrots, liver, fish oil
B_1	Thiamine	Beri-beri	Cereals, pulses, yeast
B_2	Riboflavin	Cheilosis (cracked lips)	Milk, eggs, liver
B_6	Pyridoxine	Convulsions	Cereals, fish, meat
B_{12}	Cyanocobalamin	Pernicious anaemia	Meat, fish, eggs
C	Ascorbic acid	Scurvy	Citrus fruits, amla
D	Calciferol	Rickets (children), Osteomalacia (adults)	Sunlight, fish oil, eggs
E	Tocopherol	Infertility	Vegetable oils, nuts
K	Phylloquinone	Slow blood clotting	Green vegetables, liver

Water-soluble vitamins: B-complex and C (not stored, excess excreted)

Fat-soluble vitamins: A, D, E, K (stored in liver and fatty tissues — can accumulate)

Nucleic Acids

Feature	DNA	RNA
Sugar	Deoxyribose	Ribose
Bases	A, G, C, T (Thymine)	A, G, C, U (Uracil)
Structure	Double helix	Single strand
Function	Stores genetic info	Protein synthesis
Location	Nucleus	Nucleus + cytoplasm

Base Pairing (Watson-Crick):

A = T (2 hydrogen bonds) in DNA

A = U (2 hydrogen bonds) in RNA

G ≡ C (3 hydrogen bonds) in both

Chargaff's Rule: In DNA, [A] = [T] and [G] = [C]

Important Definitions

Term	Definition
Carbohydrate	Polyhydroxy aldehyde or ketone, or compounds that give these on hydrolysis
Glycosidic Linkage	Bond between anomeric carbon of one sugar and –OH of another
Peptide Bond	–CO–NH– bond linking two amino acids
Denaturation	Loss of biological activity of protein due to disruption of higher-order structure
Nucleotide	Sugar + nitrogenous base + phosphate group
Nucleoside	Sugar + nitrogenous base (no phosphate)

Solved Examples — NCERT Based

Example 1: Reducing vs Non-reducing Sugar

Q: Why is maltose a reducing sugar but sucrose is not?

Solution: In maltose, the glycosidic bond is between C1 of one glucose and C4 of the other. The C1 of the second glucose is free → can open to form free aldehyde → gives Tollen's/Fehling's test → **reducing sugar**.

In sucrose, the bond is between C1 of glucose and C2 of fructose — both anomeric carbons are locked → no free aldehyde/ketone → **non-reducing**.

Example 2: Protein Structure

Q: What happens when a protein is denatured? Is it reversible?

Solution: Denaturation disrupts the secondary, tertiary, and quaternary structures (H-bonds, disulphide bridges, hydrophobic interactions break), but the primary structure (peptide bonds) remains intact. The protein loses its biological activity. It is sometimes reversible (if conditions are restored) but often irreversible (like cooking an egg).

Example 3: Vitamin Classification

Q: A person has night blindness and slow blood clotting. Which vitamins are deficient?

Solution: Night blindness → **Vitamin A (Retinol)** deficiency. Slow blood clotting → **Vitamin K (Phylloquinone)** deficiency. Both are fat-soluble vitamins.

Example 4: DNA Base Pairing

Q: A DNA strand has the sequence: ATGCCTA. Write the complementary strand.

Solution: Using base pairing rules (A↔T, G↔C):

Given: A T G C C T A

Complement: **T A C G G A T**

Important Questions for Board Exams

1 Mark Questions

1. What is the difference between a nucleotide and a nucleoside?
2. Name the deficiency disease caused by Vitamin C.
3. What is a glycosidic linkage?
4. Which polysaccharide is stored in the human liver?

2 Mark Questions

1. What is mutarotation? Which sugar shows it?
2. Distinguish between reducing and non-reducing sugars with examples.
3. What are essential amino acids? Name any four.
4. What is the difference between DNA and RNA (any 4 points)?

3 Mark Questions

1. Describe the four levels of protein structure.
2. Write the Haworth structure of α-D-glucose and β-D-glucose. What is the difference?
3. Classify vitamins as water-soluble and fat-soluble. Give one example and deficiency disease for each.

5 Mark Questions

1. What are carbohydrates? How are they classified? Discuss the structure of glucose with evidence.
2. What are proteins? Discuss their primary, secondary, tertiary and quaternary structures. What is denaturation?

Quick Revision Points

- Carbohydrates: mono (glucose, fructose), di (sucrose, maltose, lactose), poly (starch, cellulose)
- Glucose: aldohexose, exists as cyclic hemiacetal (α and β anomers)
- Sucrose = only common non-reducing disaccharide (both anomeric C involved)
- Starch: amylose (linear α-1,4) + amylopectin (branched α-1,4 + α-1,6)
- Cellulose: β-1,4 linked (humans can't digest — no enzyme for β-linkage)
- Amino acids: zwitterionic, all optically active except glycine
- Protein structure: 1° (sequence) → 2° (helix/sheet) → 3° (3D fold) → 4° (multi-chain)
- Fat-soluble vitamins: A, D, E, K; Water-soluble: B, C
- DNA: double helix, A=T (2 H-bonds), G≡C (3 H-bonds)
- Chargaff's rule: [A]=[T], [G]=[C]

← Previous: Amines

Next: Polymers →