

UNIT 10 • BIOMOLECULES

Structure Determination of Glucose

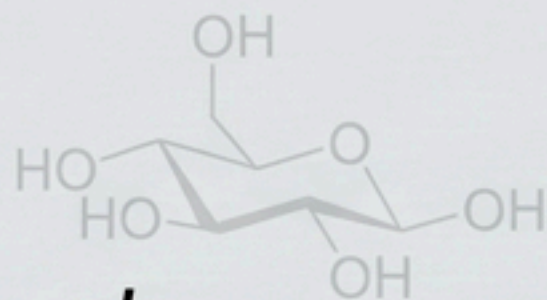
Deductive chemical logic for the
open-chain architecture.

Gluconic Acid — A 6-carbon carboxylic acid formed via mild oxidation.

Saccharic Acid — A 6-carbon dicarboxylic acid formed via strong oxidation.

Pentaacetate — The product of glucose + acetic anhydride, proving 5 separate -OH groups.

D-Configuration — Denotes relative stereochemistry at the lowest asymmetric carbon.



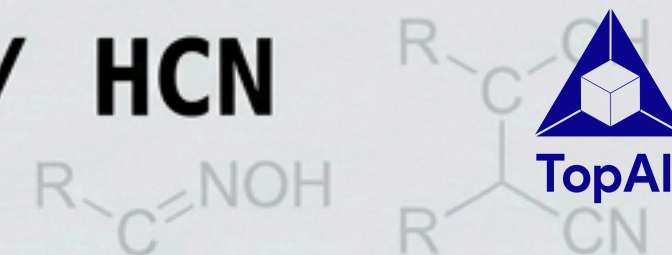
Molecular formula established by elemental analysis.

HI (Prolonged heating)



Yields n-hexane. Confirms all 6 carbons are in a straight chain.

NH_2OH / HCN

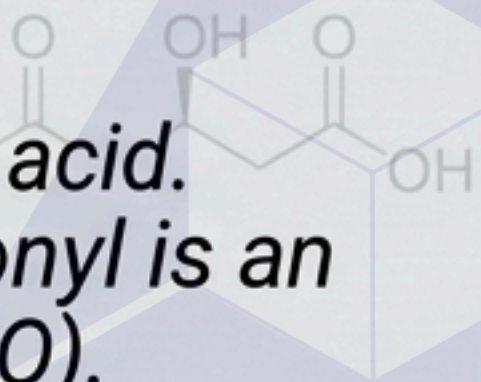


Forms oxime / cyanohydrin. Confirms a carbonyl group ($>C=O$).

Br_2 Water (Mild [O])



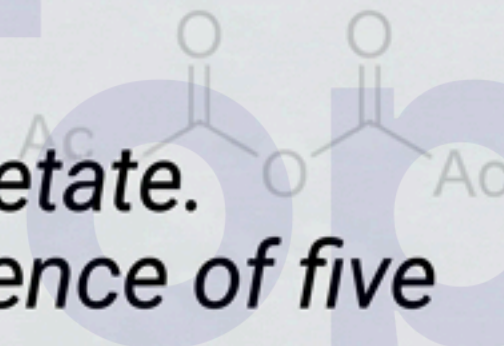
Yields gluconic acid. Confirms carbonyl is an aldehyde ($-CHO$).



Acetic Anhydride



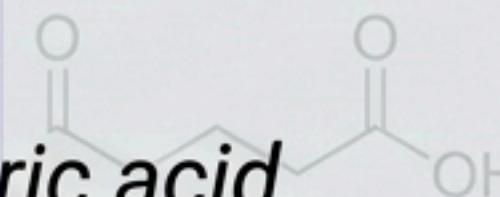
Yields pentaacetate. Confirms presence of five separate $-OH$ groups.



HNO_3 (Strong [O])



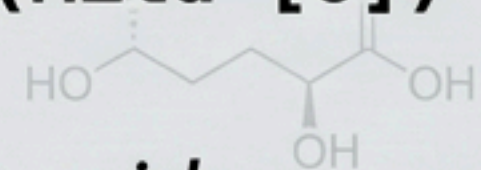
Yields saccharic acid. Confirms presence of a primary alcohol ($-CH_2OH$).



Br_2 Water (Mild [O])



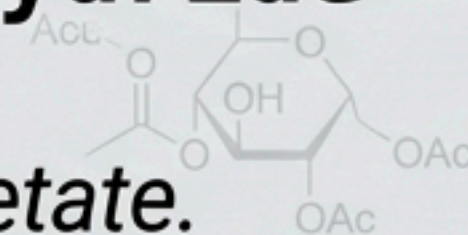
Yields gluconic acid. Confirms carbonyl is an aldehyde ($-CHO$).



Acetic Anhydride



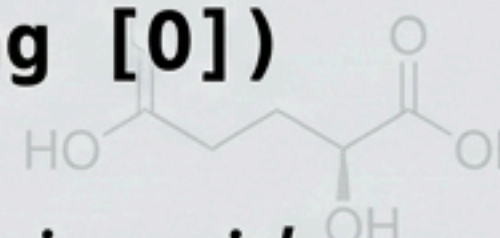
Yields pentaacetate. Confirms presence of five separate $-OH$ groups.



HNO_3 (Strong [O])



Yields saccharic acid. Confirms presence of a primary alcohol ($-CH_2OH$).





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Pinpointing the Aldehyde

Mild oxidation with Bromine water converts only the aldehyde group to a carboxyl group, leaving the rest of the chain untouched.



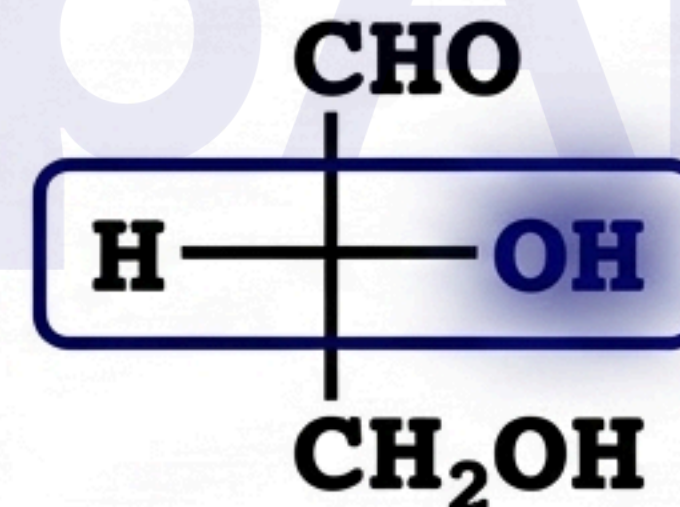
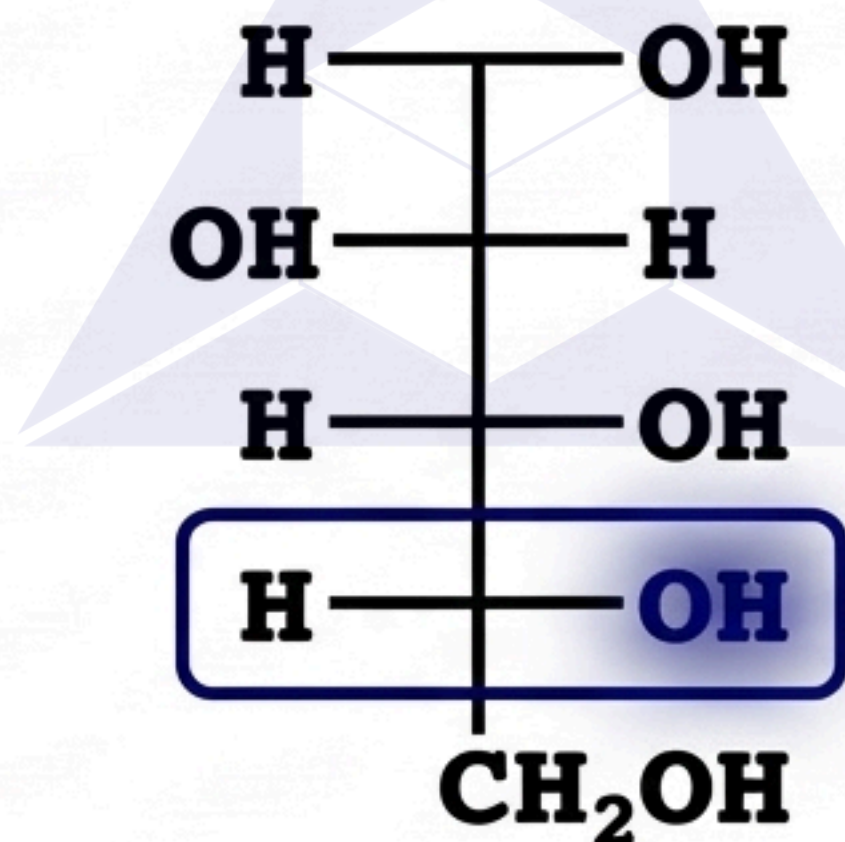
Pinpointing the Primary Alcohol

Strong oxidation with Nitric acid (HNO_3) oxidizes both the top aldehyde and the bottom primary alcohol into carboxyl groups.



Relative Configuration (The 'D' Notation)

Glucose is chemically correlated to D-(+)-glyceraldehyde by comparing the lowest asymmetric carbon (C5). Note: The structure is always written with the most oxidized carbon ($-\text{CHO}$) at the top.



⚠ WATCH FOR THIS

D/L notation $\neq$ Optical Rotation

Do not assume 'D' means dextrorotatory (+). 'D' and 'L' strictly indicate the relative spatial configuration compared to glyceraldehyde. Optical rotation—whether a molecule rotates light right (+) or left (—)—must be determined experimentally. Glucose happens to be D-(+), but D-(—) molecules exist!

Summary: Structure of Glucose

- ✓ The open-chain architecture is proven by a sequence of specific reactions: **HI** proves the 6-carbon chain, **Br₂ water** proves the aldehyde, and **HNO₃** proves the primary alcohol.
- ✓ D-(+)-glucose gets its 'D' label strictly from the right-hand placement of the –OH group on its lowest asymmetric carbon, mimicking D-glyceraldehyde.



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