SUBJECT - CHEMISTRY

CLASS - B.Sc(Hons) PART-II

PAPER - IV

TOPIC - The open chain structure of glucose.

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Q Discuss the open chain structure of glucose.

Ans on the basis of ~~exp~~ elemental analysis and molecular weight determination, the molecular formula of glucose comes $C_6H_{12}O_6$.

(1) It forms n-hexane on Complete reduction with red P & HI, Therefore all Six C-atoms in glucose are in a straight chain.

(2) It forms a penta acetyl derivative on acetylation which shows the presence of 5-OH groups. Since it does not dehydrate easily, Therefore each -OH grup is attached to a Seperate C-atom.

(3) It forms a cyanohydirin with HCN and an oxime with hydroxy -lamine, hence it Contains $>C=O$ group.

(4) on mild oxidation with Br_2 water, glucose gives gluconic acid (monobasic acid) and Contains the Same number of C-atoms as glucose. So the $>C=O$ groups in glucose must be an aldehydic.

$$H\diagdown\!\!\diagup C=O$$

(5) Gluconic acid on further oxidation with dilute HNO_3 yields glucaric acid (dibasic acid) Containing the Same number of C-atoms as glucose. As glucose has only one aldehydic group, hence the 2nd -COOH must have arisen from the oxidation of a primary (or 1°) alcoholic group $-CH_2OH$. considering above facts and Supplying necessary H-atoms.

We can Safely Say that glucose has the following open chain structure.

$$\overset{1}{C}HO\cdot\overset{2}{C}HOH\cdot\overset{3}{C}HOH\cdot\overset{4}{C}HOH\cdot\overset{5}{C}HOH\cdot\overset{6}{C}H_2OH$$

This structure explains very Satisfactorily all the foregoing facts, as Shown below:

(1) Presence of Straight Chain of Six C-atoms:

$$\text{Glucose} \xrightarrow[\text{Reduction}]{P+HI} CH_3\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_3$$

n-hexane

(2) Presence of 5-OH groups:

$$\text{Glucose} \xrightarrow{Ac_2O} CHO\cdot CHOAc\cdot CHOAc\cdot CHOAc\cdot CHOAc\cdot CH_2OAc$$

glucose penta acetate

(3) Presence of $a > C=O$ group:

$$\text{Glucose} \xrightarrow{HCN} CN\cdot CHOH\cdot CH\cdot OH\cdot CH.OH\cdot CHOH\cdot CHOH\,CH_2OH$$

glucose cyanohydrin

(4) Presence of a $\overset{H}{\underset{}{>}}C=O$ group:

$$\text{Glucose} \xrightarrow[\text{oxidation}]{Br_2/H_2O} COOH\cdot CHOH\ CHOH\cdot CHOH\,CHOH\cdot CH_2OH$$

gluconic acid

$$\xrightarrow{\text{oxidation}\ dil.\ HNO_3} COOH\cdot CHOH\cdot CHOH\cdot CHOH\cdot CHOH\cdot COOH$$

glucaric acid