

SUBJECT- CHEMISTRY

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CLASS - B.Sc(Hons) PART-11

PAPER - IV

TOPIC - Structure of citric acid:

Dr. Hari Mohan Prasad Singh

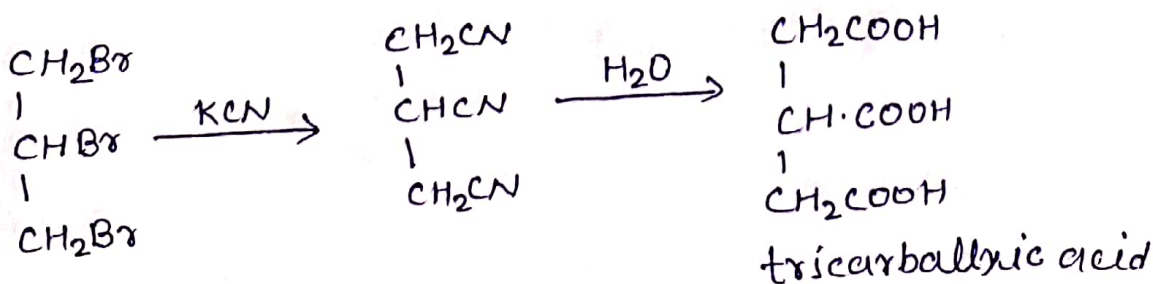
Department of Chemistry

Dr. L.K.V.D College Tarapur Samastipur

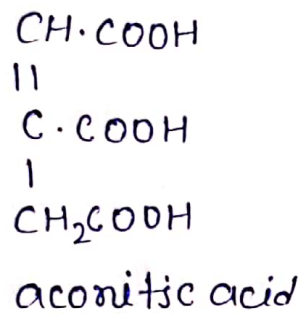
Q How would you establish the structural formula of citric acid?

Ans Structure of citric acid:

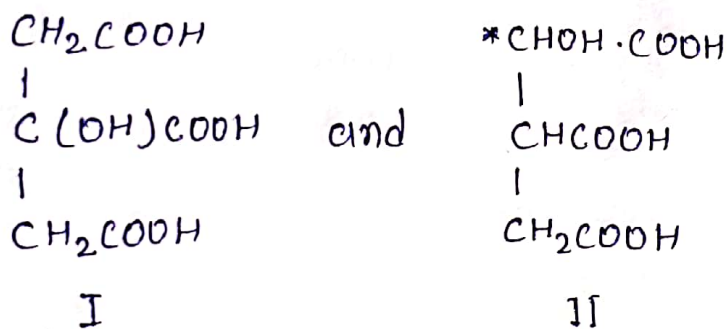
- 1 From elemental analysis and molecular weight determination its molecular formula comes $C_6H_8O_7$
- 2 It forms three series of salts and esters. Hence it has three $-COOH$ groups.
- 3 It does not evolve CO_2 on heating, so three $-COOH$ groups must be attached to three different C-atoms.
- 4 The triethyl ester of citric acid on acetylation forms a monoacetyl derivative. Therefore it contains an $-OH$ group in the molecule. Hence it can be written as $C_3H_4(OH)(COOH)_3$
- 5 When heated to 175° it loses a molecule of water to form aconitic acid which is an unsaturated acid. Aconitic acid on reduction with sodium amalgam gives tricarballic acid by adding two atoms of hydrogen. The structure of tricarballic acid has been determined by its synthesis from 1,2,3 tribromopropane as indicated below:



Since aconitic acid contains two atoms of hydrogen less than tricarballylic acid and is unsaturated, only possible structure of aconitic acid is as follows: -

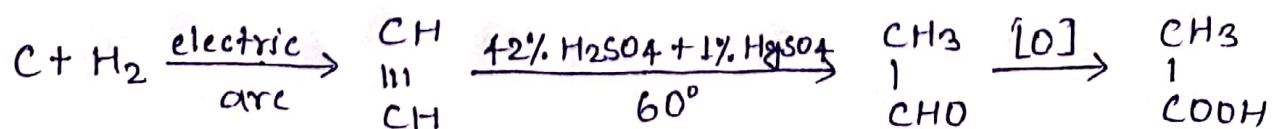


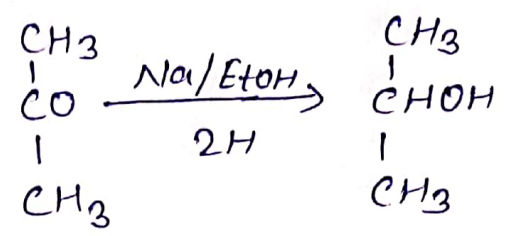
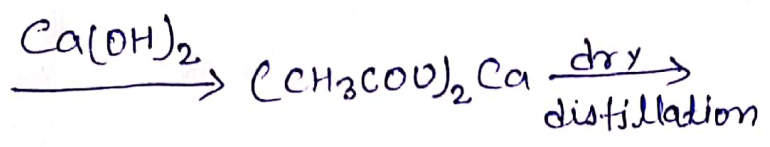
6 Aconitic acid contains one molecule of water less than citric acid which is therefore hydrated aconitic acid. Hence, the structure of citric acid may be obtained by adding a molecule of water to that of aconitic acid. This gives two possible structures of citric acid



Structure-II contains one asymmetric C-atom marked asterisk (*) But citric acid is optically inactive. Hence, Structure-II is rejected. Structure-I is confirmed by its synthesis.

Synthesis: only outline is indicated below:





acetone Isopropyl alcohol

