

Cannizzaro reaction

Aim

- Synthesis of benzoic acid and benzyl alcohol.

Theory

The Cannizzaro reaction is when a non-ionizable aldehyde reacts with itself in a strong base, such as sodium hydroxide (NaOH), to form a carboxylic acid and an alcohol. A non-ionizable aldehyde is one that has no alpha hydrogens available for the aldehyde to form an enol. This reaction is a redox reaction in which two molecules of an aldehyde are reacted to produce a primary alcohol and a carboxylic acid using a hydroxide base.

Cannizzaro reaction

Both alcohols and organic acids are well known for their biological actions.

- 1- Antibacterial properties.
- 2- Preservatives for food.
- 3- pharmaceutical local application as antiseptics.

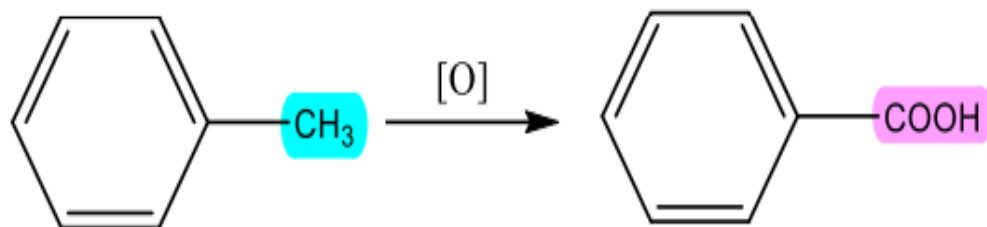
Benzyl alcohol has some local anesthetic properties, it is useful as an antipruritic and is the reason for its inclusion in some dental remedies and injectables in pharmaceutical preparations intended for local application, benzyl alcohol has been used up to 10 % in ointments as an antipruritic and to prevent secondary infections. Benzyl alcohol can be prepared by the hydrolysis of benzyl chloride with sodium hydroxide.

Cannizzaro reaction

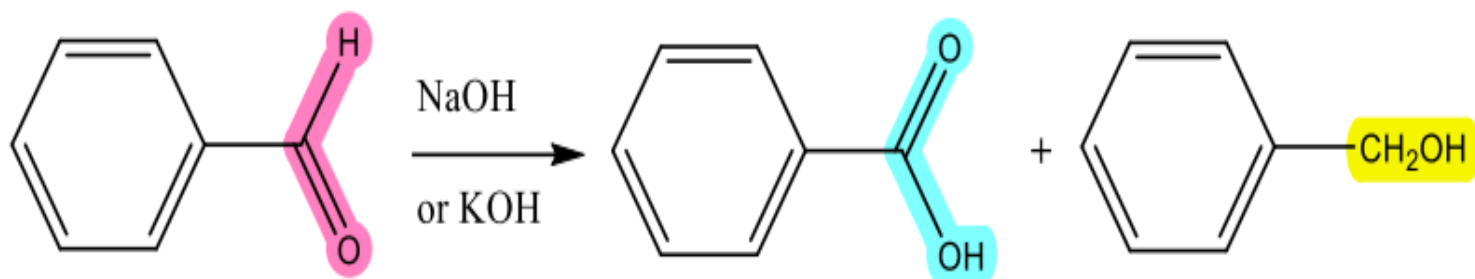
On the other hand, benzoic acid is used as a food preservative as a free acid, or in the form of sodium salt, and also used externally in the form of lotions, ointments, mouthwashes, etc.

Benzoic can be prepared by the oxidation of toluene using an oxidizing agent.

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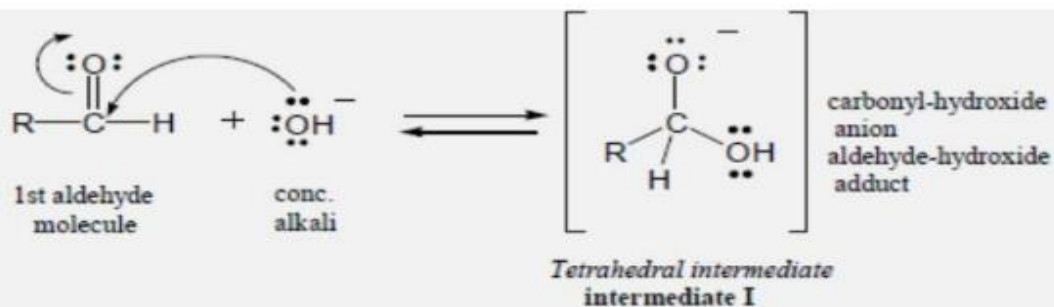


However, both benzoic acid and benzyl alcohol can be prepared in the laboratory by Cannizzaro reaction by the action of sodium or potassium hydroxide on benzaldehyde.

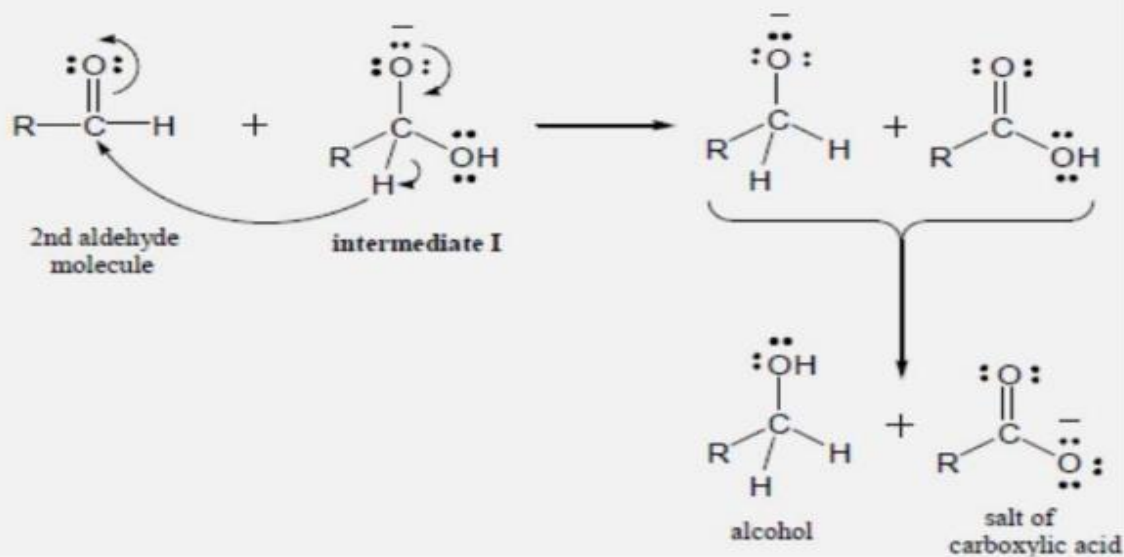


Mechanism of action

 *Step I*



 *Step II*



Cannizzaro reaction

- Properties of benzyl alcohol
- 1- Colorless to very fine yellow (due to oxidation) oily liquid.
- 2- Immiscible with water, miscible with organic solvents like ether.
- 3- The boiling point is 204-207 °C

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- Properties of benzoic acid
- 1- White crystalline plates or needles.
- 2- Sparingly soluble in water, soluble in hot boiled water.
- 3- Volatile with steam (so can be purified by Steam distillation).
- 4- Reacts with sod. bicarbonate to give CO₂ gas
- 5- The melting point is 121-123 °C.

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Procedure

- 1- Dissolve 2 g of NaOH in about 10 ml of H₂O contained in a beaker.
- 2- Cool the solution to about 20 °C. in an ice-water bath.
- 3- Pour the solution into a 50 ml reagent bottle.
- 4- Add 9.6 ml of pure benzaldehyde, cork the bottle securely, and shake the mixture vigorously until it has been converted to a thick emulsion.
- 5- Allow the mixture to stand overnight (in this case until the next laboratory period). By which time the reaction should have been completed.

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