

Online Class of Chemistry Honours Sem – IV , CC – 10

BY

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Demjanov rearrangement :

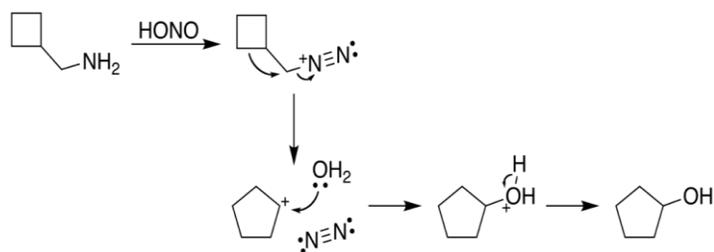
The **Demjanov rearrangement** is the chemical **reaction** of primary amines with nitrous acid to give **rearranged** alcohols. It involves substitution by a hydroxyl group with a possible ring expansion. It is named after the Russian chemist Nikolai Jakovlevich **Demjanov** (Dem'anov, Demianov) (1861–1938).

The conversion of primary amines into alcohols by means of the diazotization of those amines with nitrous acid, accompanying the migration of the carbon atom when the primary amino groups are on the ring or at the α -position of the side chain, is generally referred to as Demjanov rearrangement or Demjanov reaction. It has been observed that in the case of cyclic aliphatic amines, alcohols with enlarged or contracted rings are formed, depending on the position of the amino group. This reaction has been applied in the preparation of cyclic compounds with different sizes.

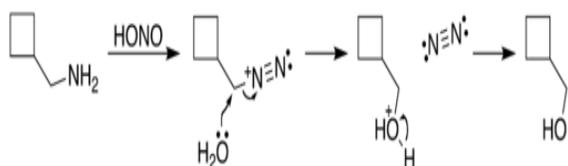
The reaction process begins with diazotization of the amine by nitrous acid. The diazonium group is a good leaving group, forming nitrogen gas when displaced from the organic structure. This displacement can occur via a rearrangement (path A), in which one of the sigma bonds adjacent to the diazo group migrates. This migration results in an expansion of the ring. The resulting carbocation is then attacked by a molecule of water. Alternately, the diazo group can be displaced directly by a molecule of water in an S_N2 reaction (path B). Both routes lead to formation of an alcohol.

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Path A



Path – B

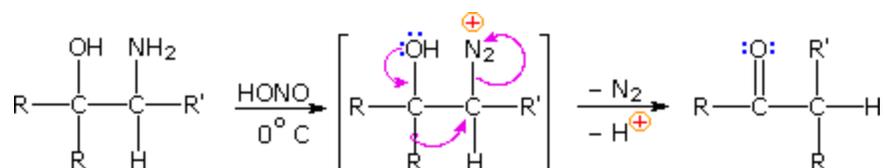


Tiffeneau–Demjanov rearrangement :

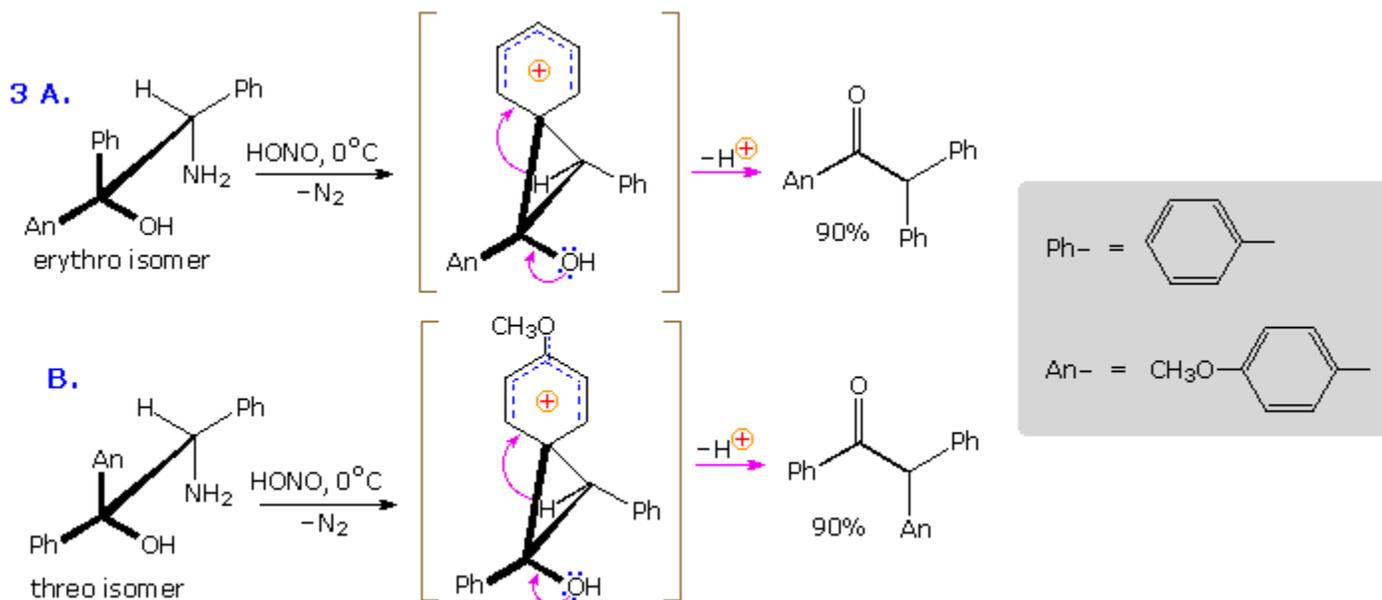
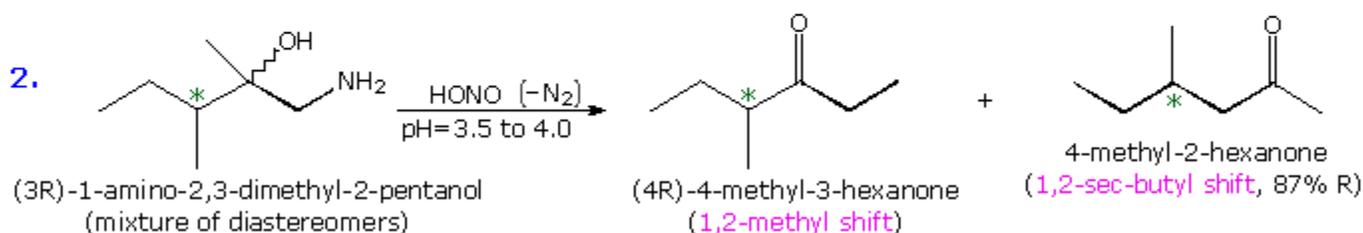
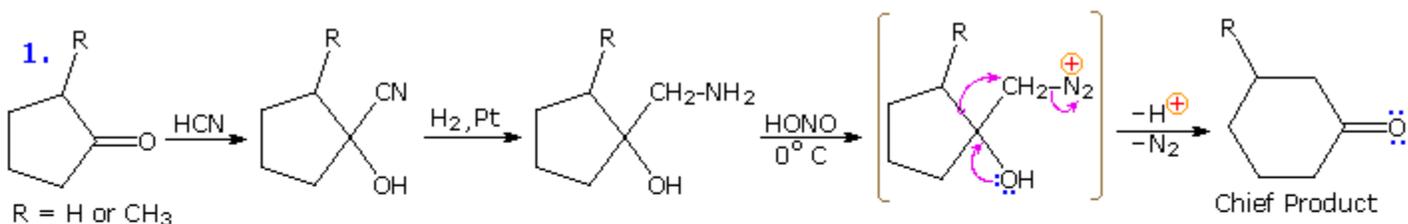
The **Tiffeneau–Demjanov rearrangement (TDR)** is the chemical reaction of a 1-aminomethyl-cycloalkanol with nitrous acid to form an enlarged cycloketone.

The Tiffeneau–Demjanov ring expansion, Tiffeneau–Demjanov rearrangement, or TDR, provides an easy way to increase amino-substituted cycloalkanes and cycloalkanols in size by one carbon. Ring sizes from cyclopropane through cyclooctane are able to undergo Tiffeneau–Demjanov ring expansion with some degree of success. Yields decrease as initial ring size increases, and the ideal use of TDR is for synthesis of five, six, and seven membered rings. A principal synthetic application of Tiffeneau–Demjanov ring expansion is to bicyclic or polycyclic systems. Several reviews on this reaction have been published.

Ambiguity in determining the initial site of carbocation formation presented a problem in the analysis of many pinacol rearrangements. This uncertainty can be removed by nitrous acid deamination of the corresponding 1°-aminoalcohols, as shown in the following equation. Since this reaction is normally carried out under very mild conditions, the possibility that subsequent transformations may obscure the initial rearrangement is reduced considerably.



The Tiffeneau-Demjanov rearrangement is often used to transform a cyclic ketone into a homologue that is one ring size larger. Such an application, which proceeds by way of a cyanohydrin intermediate, is shown in the first example below. Cyclic ketones have two alpha-carbon atoms, each of which might shift to the nascent 1°-carbocation. If R = H in the case shown here, these two groups are identical and on shifting give the same product. If R = CH₃, the 2°-alkyl group shifts preferentially, the chief product being 3-methylcyclohexanone; the 2-methyl isomer is a minor product. The second reaction is informative because it demonstrates that the chiral 2°-butyl group moves with retention of configuration.



The third example illustrates the importance of substrate configuration on the course of rearrangement. The initial stage of an aryl group shift to an adjacent carbocation site may be viewed as an intramolecular electrophilic substitution of the Friedel-Crafts type. Aryl ring approach from the side opposite to the departing nitrogen of the diazonium ion generates a

phenonium ion intermediate (shown in brackets above), the structure of which is similar to a benzenonium ion. In these two examples, diastereomeric reactants lead preferentially to diastereomeric intermediates, even though the anisyl group has a much greater migratory aptitude than phenyl. Electron pair donation by the hydroxyl substituent then acts to open the three-membered ring of these intermediates, yielding the ketone products.

