

# NaI (Sodium Iodide) Test

Functional Group(s): Primary and secondary alkyl halides

Known(s): Alkyl bromide starting material; Alkene standard(s) for your reaction

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## Procedure

Set up a test tube rack containing 3-4 small (75mm X 12mm) test tubes. Label the test tubes 1-3 (or 1-4). Add ~1 ml of the sodium iodide in acetone reagent to each tube. Add 5-8 drops of the alkyl bromide to tube 1, 5-8 drops of the reaction mixture to tube #2 and 5-8 drops of the alkene to tube #3 (if more than one alkene is used, add another tube to the set up). Note the amount of time that elapses from when the solution is added to the reagent and when a result is observable. Observe and record the results immediately, and after 1-3 minutes. If no changes occur at room temperature, vortex the solutions for 20-30 seconds. If still no changes occur, warm the tubes in a ~50°C water bath. To warm the tubes, set a beaker with water in it on the hot plate. Heat the water until just below boiling. Using a test tube clamp, warm each tube in the water for 3-5 minutes. (*Do not set the tubes in the water bath without being clamp. They will fall into the bath and results cannot be evaluated!*). Observe each tube for the formation of a precipitate or color change.

## Results

The formation of a precipitate (NaCl or NaBr) is an indication that the tested compound contains a primary or secondary alkyl halide (i.e., alkyl halides that are sterically unhindered). This test is most useful when run alongside the silver nitrate in ethanol test, especially to distinguish between primary and tertiary alkyl halides.

## Theory

In the presence of sodium iodide in acetone, alkyl halides that are not sterically hindered (i.e., primary or secondary) react with the iodide nucleophile through an  $S_N2$  mechanism. The halogen of the alkyl halide serves as leaving group at the reactive  $sp^3$  hybridized carbon. The iodide displaces the halogen leaving group, resulting in a substituted product (alkyl iodide) and a sodium salt (NaBr or NaCl). Sodium iodide is soluble in acetone, however, sodium bromide and sodium chloride (by-products of this reaction) are not. These insoluble salts may precipitate from the reaction mixture, indicating that the  $S_N2$  reaction occurred. Substitution of an unknown alkyl iodide with NaI will form NaI as a by-product, and so no precipitate will be observed. Therefore, this test will not be useful for identifying alkyl iodides.

