Aldehydes and Ketones

Objectives:
- Observe the reactions of aldehydes and ketones
- Identify two unknown chemicals as aldehydes, methyl ketones, or neither.

Background:
The major similarity between an aldehyde and a ketone is the carbonyl group. A carbonyl group is a carbon atom doubly bonded to an oxygen atom, as depicted below.

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  O
----C----
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Both molecules have a carbonyl group, the aldehyde and ketone differ in what atom is bonded to the carbonyl carbon. The carbonyl carbon of an aldehyde is bonded to two hydrogens or one hydrogen and one carbon. The carbonyl carbon of a ketone is bonded to two carbons.

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<tbody>
<tr>
<td>R—C—H</td>
<td>R—C—R</td>
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<tr>
<td>aldehyde</td>
<td>ketone</td>
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Remember that the ‘R’ symbolizes any carbon side-chain, from one carbon to a million carbons. The carbonyl group of an aldehyde is on the terminal (last) carbon and the carbonyl group of the ketone is not.

Three tests will be used in this experiment.
1. Iodoform test
2. Chromic acid test
3. Tollens’ test

Both chromic acid and Tollens’ reagent are used to differentiate between aldehydes and ketones. Aldehydes are oxidized relatively easily, while ketones are not easily oxidized.

The chromic acid will change in color from orange to green when it oxidizes an aldehyde.

The Tollens’ reagent, composed of a silver-ammonium ion, will form solid silver as it oxidizes that aldehyde. This silver will plate a glass surface creating a mirror.

The iodoform test specifically for methyl ketones by giving a yellow precipitate.

Procedure:
1. Your observations are the most important aspect of this lab. Remember to be as descriptive as possible and highly organized. Carefully record all observations in a data table in your lab book.

Test 1, Iodoform Test
2. In separate test tubes from your drawer, place 5 drops each of butanal, acetone, and unknowns A, B & C.
3. Add 1 mL of H2O to each tube.
4. To each test tube, add .5 mL of 10% NaOH (which may be labeled as 3M NaOH).
5. Add 10 drops of the I2-KI test reagent while shaking.
6. Examine the tubes for a yellow precipitate. Set them aside and examine them again after you’ve completed the other tests; formation of the precipitate can be slow.
7. At the end of the period, discard the waste in the halogenated organic waste container. Rinse with a small amount of acetone, and place the rinse in the halogenated waste container. Then wash the test tubes with soap and water.

Test 2, Chromic Acid (Bordwell’s reagent)
8. In a disposable test tube, add 10 drops of butanal, and add 1 drop of chromic acid and agitate.
9. Repeat step 12 four times, substituting acetone and unknowns A, B & C.
10. Discard all waste in the chromium/organic waste container. Rinse your test tubes with a little acetone and discard the rinse in the chromium/organic waste container. Remove the labels and place test tubes in the dirty test tube box.

Test 3, Tollens’ test
11. In a disposable test tube, add 15 drops of 6M NaOH and wait two minutes.
12. Empty the test tube into the sink, do not rinse or clean, add 15 drops of .1M silver nitrate.
13. Add 15 drops of 6M ammonium hydroxide and agitate until the precipitate is dissolved.
15. Repeat steps 9-12 four times: once with acetone and once with each of your unknown.
16. Discard all waste in the silver/organic waste container. Rinse your test tubes with a little acetone and discard the rinse in the silver/organic waste container. Remove the labels and place test tubes in the dirty test tube box.
17. Using all the data you have just collected, identify the unknowns as aldehydes, methyl ketones or neither.

Lab Report:

Pre-lab
Write your title, purpose, procedure, and set up your data table.

During lab
Fill in your data table.

Post-lab
Analysis: Explain how you identified each of your unknowns as either an aldehyde, a methyl ketone, or neither. Be specific, explaining the purpose of a negative test as well as a positive test.

Discussion: Restate the identities of your unknowns. Explain the utility of each test. Draw the structures for two aldehydes and two ketones and name each.