LAB Report Experiment 2 Reactions OF Aldehydes AND Ketones

Organic Chemistry (Universiti Teknologi MARA)

UNIVERSITI TEKNOLOGI MARA

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EXPERIMENT 2

REACTIONS OF ALDEHYDES AND KETONES

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a)2,4-Dinitrophenylhydrazine test

OBJECTIVE:

To detect ketones and aldehydes

To shows positive test for aldehydes and ketones.

CHEMICALS:

1. Organic compound
2. rectified spirit
3. 2,4-Dinitrophenylhydrazine solution

APPARATUS:

1. Test tube
2. Droppers

PROCEDURES:

1.A small quantity of organic compound took into a test tube.

2.A small amount of rectified spirit added to the same test tube using a dropper.

3.The test tube shakes well to dissolve the compound in rectified spirit.

4.A small quantity of 2,4-Dinitrophenylhydrazine solution was added into the test tube using another dropper.

5.The result of the reaction recorded in a table.

RESULTS:

TEST	OBSERVATION
2,4-Dinitrophenylhydrazine	2,4-Dinitrophenylhydrazine reacts with the carbonyl group. It forms a yellow or orange precipitate.

DISCUSSION:

DNPH is a reagent in instructional laboratories on qualitative organic analysis. Brady's reagent or Borche's reagent, is prepared by dissolving 2,4-dinitrophenylhydrazine in a solution containing methanol and some concentrated sulfuric acid. This solution is used to detect ketones and aldehydes. A positive test can be known by the formation of a yellow, orange or red precipitate of the dinitrophenylhydrazone. Aromatic carbonyls give red precipitates whereas aliphatic carbonyls give more yellow color. The reaction between 2,4-dinitrophenylhydrazine and a generic ketone to form a hydrazone is shown below;

$RR'C=O + C_6H_3(NO_2)_2NHNH_2 \rightarrow C_6H_3(NO_2)_2NHN=CRR' + H_2O$

CONCLUSION:

The conclusion the test suits its objective to detect ketones and aldehydes and shows positive test for aldehydes and ketones. This reaction is a condensation reaction as two molecules joining together with loss of water. Mechanistically, it is an example of addition-elimination reaction. Nucleophilic addition of the $-NH_2$ group to the C=O carbonyl group. DNP-derived hydrazones have characteristic melting points, facilitating identification of the carbonyl. The results shown 2,4-Dinitrophylhydrazine reacts with the carbonyl group present in aldehyde to form a yellow or orange precipitate of 2,4-Dinitrophenylhydrazone.

REFERENCES:

1)http://dept.harpercollege.edu/chemistry/chm/100/dgodambe/thedisk/qual/dnp.htm
2)https://en.m.wikipedia.org/wiki/2,4-Dinitrophenylhydrazine
3)https://en.wikipedia.org/wiki/2,4-Dinitrophenylhydrazine#DNP_test
4) https://www.youtube.com/watch?v=X7ZJqLEhX9k&t=11s

b) Sodium Bisulphite Test

OBJECTIVE:

To identify aldehydes and the presence of the carbonyl group.

CHEMICALS:

Organic compound, saturated solution of sodium bisulphite

APPARATUS:

Boiling tube, dropper, a cork

PROCEDURES:

1. A small quantity of saturated solution of sodium bisulphite has been taken in a boiling tube.
2. A small quantity of organic compound has been added using a dropper.
3. The test tube then has been corked with the cork and has been shaked well and leaves it for some time.
4. Any observation has been recorded.

RESULTS:

Test	Observation
Sodium bisulphite test	• Aldehyde gives an addition product with sodium bisulphite, which is white crystalline in nature.

DISCUSSION:

The chemical compound sodium bisulfite (also known as sodium bisulphite or sodium hydrogen sulfite) has the formula NaHSO3. Sodium bisulfite is a combination of salts that dissolve in water to produce sodium and bisulfite ion solutions. It is a white solid with a sulphur dioxide odour. In this experiment, a small quantity of saturated solution of sodium bisulphite has been taken in a boiling tube. Then, a small quantity of organic compound has been added using a dropper. After that, the test tube then has been corked with the cork and has been shaked well and leaves it for some time. The result is the aldehyde gives an addition product with sodium bisulphite, which is white crystalline in nature and this is a positive result.

CONCLUSION:

In the conclusion, the objective of this experiment was learned that how to identify aldehydes and the presence of the carbonyl group.

REFERENCES:

1.https://en.wikipedia.org/wiki/Sodium_bisulfite
2.https://pubchem.ncbi.nlm.nih.gov/compound/Sodium-bisulfite

c) Schiff ‘s Test

OBJECTIVE:

Learn how to differentiate between aldehydes and ketones using qualitative analysis

CHEMICALS:

1.Organic compound

2.Schiff ‘s reagent

APPRATUS:

1.Test tube

2.Dropper

3.Tube racks

PROCEDURE:

1.A small quantity organic compound has been taken in as test tube.

2.A small amount of Schiff ‘s reagent has been added using a dropper.

3.The test tube has been shaken gently.

4.Any observation has been recorded.

RESULT:

Test	Observation
Schiff ‘s Test	• The colour of the solution turns to dark purple with aldehyde.

DISCUSSION :

The Schiff ‘s reagent is the reaction product of a dye formulation such as fuchsin and sodium bisulfite; pararosaniline (which lacks an aromatic methyl group) and new fuchsin (which is uniformly mono-methylated ortho to the dye ‘s amine functionalities) are not dye alternatives with comparable detection chemistry. In this experiment , a small quantity of organic compound has been taken in a test tube . Next ,a small amount of Schiff ‘s reagent has been added to the test tube right after the organic compound has been added using a dropper . The test tube shaken gently.The result is the colour of the solution turn to dark purple . An aldehyde react with Schiff ‘s reagent to produce a magenta colour which is a positive result while ketone does not react with Schiff ‘s reagent.

CONCLUSION:

In the conclusion, the objective of this experiment was learned that how to differentiate between ketone and aldehydes using qualitative analysis.

REFERENCES:

1.http://myweb.liu.edu/~nmatsuna/che122/exp13.pdf

2.https://www.chemistrylearner.com/schiff-reagent.html#schiff-reagent-test

d) Tollen's Test

OBJECTIVE:

To detect the presence of aldehyde containing carbohydrates and differentiate them from ketone containing carbohydrates.

CHEMICALS:

1.Organic compound
2.Silver nitrate
3.Dilute sodium hydroxide
4.Dilute ammonium hydroxide

APPARATUS:

1.Test tubes
2.Droppers
3.Water bath

PROCEDURES:

1.A small quantity of silver nitrate solution has been taken in a test tube using a dropper.
2.To this a few drops of dilute sodium hydroxide solution has been added using a dropper.
3.Using another dropper, excess of dilute ammonium hydroxide has been added to the precipitate and the test tube has been shaken well. The precipitate dissolves in ammonium hydroxide.
4.A dropper is used to add a small quantity of organic compound to the test tube.
5.The test tube has been boiled in a boiling water bath. Any observation has been recorded.

RESULT:

TEST	OBSERVATION
Tollen's Test	Aldehyde reduces silver ions in the test reagent to elemental silver which is accumulated on the inner surface of the test tube, producing a silver mirror. Dark grey precipitate or silver mirror

DISCUSSION:

Tollen's Test is used in organic chemistry to test for the presence of aldehydes. In this reaction, an aldehyde is oxidized to a carboxylic acid while the Ag^{1+} is reduced to silver metal, which deposits as a thin film on the inner surface of the glass. The generic reaction is as follows and is specific for aldehyde:

$$RCHO + 2\ Ag\ (NH_3)_2^+ + 3\ OH^- \quad \rightarrow \quad RCOO^- + 2\ Ag(s) + 4\ NH_3 + 2\ H_2O$$

CONCLUSION:

Tollen's reagent is a chemical reagent used to distinguish between aldehydes and ketone functional groups along with some alpha-hydroxy ketones which can tautomerize into aldehydes. The reagent consists of a solution of silver nitrate, ammonia and sodium hydroxide.

REFERENCES:

1. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Aldehydes_and_Ketones/Reactivity_of_Aldehydes_and_Ketones/Tollens_Test
2. https://microbenotes.com/tollens-test/
3. https://www.chemguide.co.uk/organicprops/carbonyls/oxidation.html
4. https://youtu.be/X7ZJqLEhX9k

e) Fehling Test

OBJECTIVE:

Learn how to determine whether a carbonyl – containing compound is an aldehyde or a ketone .

CHEMICALS:

1.Organic compound

2.Fehling 's solution A

3.Fehling 's solution B

4.Water

APPRATUS:

1.Tube racks

2.Test tube

3.Dropper

4.Beaker

PROCEDURE:

1.A small quantity of organic compound has been taken in test tube.

2.A small amount of Fehling ‘s solution A has been added using a dropper.

3.Using another dropper, a small quantity of Fehling ‘s solution B has been added into the test tube.

4.The test has been heated in a boiling water bath.

5.Any formation of precipitate was observed.

RESULTS:

TEST	**OBSERVATION**
Fehling test	The colour of the mixture has changed from blue into red. A brick – red precipitate is formed.

DISCUSSION:

A small amount of organic compound was placed in a test tube for this experiment. So, using a dropper, a small volume of Fehling's solution A and a small quantity of Fehling's solution B were applied to the test tube. Since the copper (II) complex generated by their combination is not stable, these two solutions are combined as required for the test. After that, the tube test was heated in a water bath at a high temperature. Following the heating process, the colour of the mixture changed from blue to red-brick, and a red precipitate emerged. Ketones, whether they are -hydroxy ketones, do not react when aldehydes are oxidised, giving a positive outcome.

The explanation for this is that the bistartratocuprate (II) complex oxidises the aldehyde to a carboxylate anion, reducing the copper (II) ions in the complex to copper(I) ions in the process.

The reaction mixture then precipitates red copper(I) oxide, indicating a successful reaction. The carboxylic acid forms a salt, carboxylate (RCOO-) and water, when it reacts with the alkali.

$$RCHO + 2Cu^{2+} + 5OH^{-} \rightarrow Cu_2O(S) + RCOO^{-}(S) + 3H_2O$$

Aldehyde Fehling 's solution Cuprous oxide red

CONCLUSION:

To summarise, the aim of this experiment was to learn how to tell whether a carbonyl-containing compound is an aldehyde or a ketone. This indicates that the substance is an aldehyde.

REFERENCE:

1.https://en.wikipedia.org/wiki/Fehling%27s_solution

2.https://www.chemistrylearner.com/fehlings-solution.html

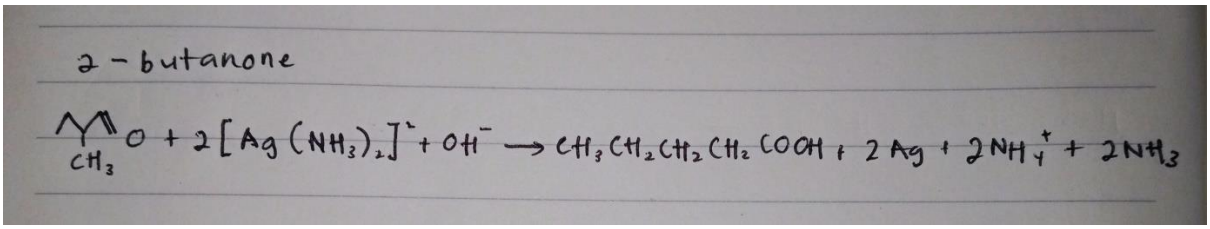
3.https://chemdemos.uoregon.edu/demos/Fehling-Test#:~:text=Fehling's%20can%20be%20used%20to,an%20aldehyde%20or%20a%20ketone.&text=The%20compound%20to%20be%20tested,are%20alpha%2Dhydroxy%2Dketones.

QUESTIONS:

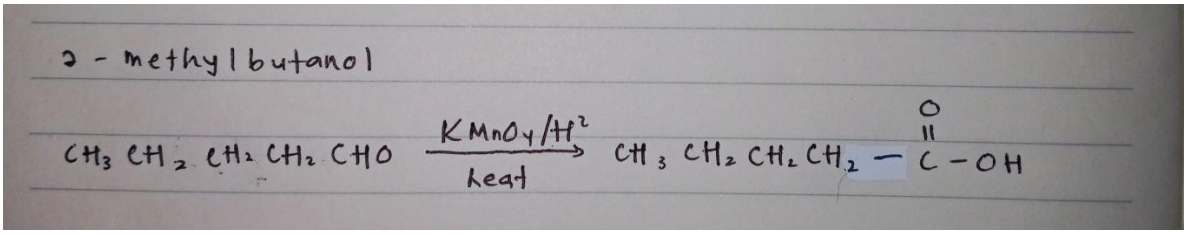
1.Distinguish between 2-butanone and 2-methylbutanal by using Tollen's reagent and potassium permanganate KMnO4 solution. Write the equation involved.

KMnO4 is also known as potassium permanganate. 2-butanone will turn into aldehyde using the two solutions, while 2-methylbutanal turns into ketone. The different in the structure of aldehydes compared to ketones is the hydrogen that attach to the aldehydes as ketones do not have the hydrogen atom.

There is no reaction occur when 2-butanone added with Tollen's reagent because ketone do not react with it.



2-methylbutanal will undergo oxidation when react with KMnO4.



2.Why do aldehydes react with Tollen's reagent but ketone do not?

The presence of that hydrogen atom makes aldehydes very easy to oxidise. Ketones don't have that particular hydrogen atom, they are resistant to oxidation. Only very strong oxidising agents like potassium manganate (VII) solution (potassium permanganate solution) oxidise ketones.

3.Why aldehydes are reactive than ketones?

The carbonyl carbon in aldehydes generally has more partial positive charge than in ketones due to the electron-donating nature of alkyl groups. Aldehydes only have one e- donor group while ketones have two.

4.Can Fehling solution oxidize a secondary alcohol?

Fehling's solution does not oxidize alcohols because the copper complex does not have enough oxidizing power to activate alcohols.

5.What is haloform test?

Haloform test is a chemical reaction of methyl ketone with a halogen such as chlorine, bromine, or iodine. The reaction can be used to transform acetyl groups into carboxyl groups or to produce chloroform, bromoform or iodoform. There is one aldehyde that undergoes the haloform reaction, which is acetaldehyde. For example, when the halogen used is iodine, the haloform reaction can be used to identify methyl ketones because iodoform is a yellow solid with a characteristic odor. The test is known as the iodoform test.