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CHM301 – ORGANIC CHEMISTRY II

SCIENTIFIC LAB REPORT

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CLASS GROUP: **AS1204_I**
EXPERIMENT TITLE: **REACTIONS OF ALDEHYDE AND KETONE**

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1.1 OBJECTIVE

To study the reaction for aldehyde and ketone

1.2 INTRODUCTION

Aldehyde, is an any of a class of an organic compounds in which a carbon atom shares a double bond with oxygen atom, a single bond of hydrogen atom and a single bond with another atom or group of atoms with it. For the example is CH3CHO (ethanal).

Ketones is a carbon that attach with double bond of oxygen, a single bond of R group and another single bond of R' group. The structure of ketone is like this RC(=O)R' where R and R' can be any carbon containing substituents. For the example is CH3C(=0)CH3 (propanone).

There are many tests that can be used to determine whether the solution is ketone or aldehyde. The tests are, Fehling's Test, Iodoform Test, Schiff's Test, Tollen's test and Brady's Test.

The Fehling Test / Benedict Test, the positive test or result will disappear the blue colour of the Fehling solution and brick-red precipitate is obtained. For the negative test, blue colour of the Fehling solution will remain. For the Iodoform Test, the positive test will produce yellow precipitate of triiodomethane. For the negative result, the yellow precipitate not formed and the colourless of the solution will remains.

For the Schiff Test, the positive result will show by formation of magenta-pink colour. For the negative result formation of magenta-pink colour does not happen. For the Tollen's Test or silver mirror test, the positive test will form silver mirror but for the negative test, the silver mirror did not form. Lastly, for the Brady's Test, the positive result will form orange precipitate and the negative result did not formed orange precipitate.

1.3 APPARATUS

Test tubes, test tube holder, dropper, beaker, glass rod, hotplates

1.4 CHEMICALS

- Aliphatic aldehyde (Solution A)
- Aromatic aldehyde (Solution B)
- Simple ketone (Solution C)
- Cyclic ketone (Solution D)
- 10% NaOH solution
- Iodine solution

1.5 REAGENTS

- Fehling's reagent
- Schiff's reagent
- Silver nitrate solution and ammonia (Tollen's test)
- 2,4-dinitrophenylhydrazine (2,4-DNPH)

1.6 PROCEDURE

a. Fehling's Test

1. 4 clean test tubes labelled with A, B, C, D have been filled with 1cm3 of Fehling reagent each respectively

2. Few drops of unknown solution from solution that labelled as solution A, solution B, solution C and solution D have been added into each test tube according to its label.

3. The test tubes have been stirred to get homogeneous solution.

4. As it showed no changes, the test tubes will be heat by placing them in a beaker that contains water on the hotplate.

5. In about 5 minutes the result was observed.

b. Schiff's test

1. 4 clean test tubes labelled with A, B, C, D have been filled with 1cm3 of Schiff reagent each respectively

2. 1 drop of unknown solutions from solution that labelled as solution A, solution B, solution C and solution D have been added into each test tube according to its label.

3. Stoppered the test tubes to shake it vigorously to see formation of emulsion.

4. Result was observed.

c. Iodoform test

1. 4 clean test tubes labelled with A, B, C, D have been filled with 1cm3 of NaOH solution each respectively.

2. 5 drops of unknown solutions from solution that labelled as solution A, solution B, solution C and solution D have been added into each test tube according to its label.

3. Iodine solution was added drop by drop until the colour of iodine stays.

4. Result was observed.

d. Tollen's test

1. 4 clean test tube labelled with A, B, C, D have been filled with 1cm3 of silver nitrate each respectively

2. 1 drop of 10% Sodium Hydroxide has been added into each test tubes. Grey solution formed.

3. 5% ammonia solution was added drop by drop until it becomes colourless solution with the help of stir rod to mix it.

4. 1cm3 of unknown solutions from solution that labelled as solution A, solution B, solution C and solution D have been added slowly into each test tube according to its label.

5. The solution in the test tubes has been mix slowly to see the results

6. As it showed no changes of the solution into silver mirror, the test tubes will be heat by placing them in a beaker that contain with hot water on the hotplate.

7. In about 5 minutes the result was observed.

e. Brady's test

1. 4 clean test tube labelled with A, B, C, D have been filled with 4cm3 of 2,4-dinitrophenylhydrazine each respectively.

2. 4 drops of unknown solutions from solution that labelled as solution A, solution B, solution C and solution D.

3. The solution in the test tubes has been mix slowly to see the results.

4. The result was observed.

1.7 RESULTS

a. Fehling's test

Solution	Observation
A	Brick-red precipitate formed
B	No reaction
C	No reaction
D	No reaction

b. Schiff's test

Solution	Observation
A	Reagent colour change into dark purple colour
B	Reagent colour change into dark purple colour
C	Reagent colour change into pink colour
D	No change

c. Iodoform test

Solution	Observation
A	Colourless solution turns into yellow
B	Colourless solution turns into yellow
C	Yellow precipitate was formed
D	Yellow colour layer formed on top of the solution

d. Tollen's test

Solution	Observation
A	Silver mirror colour formed
B	Silver mirror colour formed
C	No change
D	No change

e. Brady's test

Solution	Observation
A	Clear yellow colour turns into cloudy yellow
B	Clear yellow colour turns into cloudy orange
C	Clear yellow colour turns into cloudy yellow
D	Clear yellow colour turns into cloudy yellow

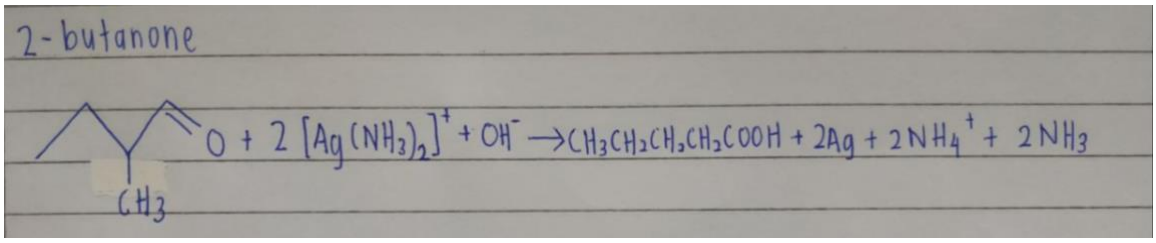
1.8 QUESTION

What is your observation if you differentiate 2-butanone and 2-methylbutanal using Tollen's reagent. Write equation involved.

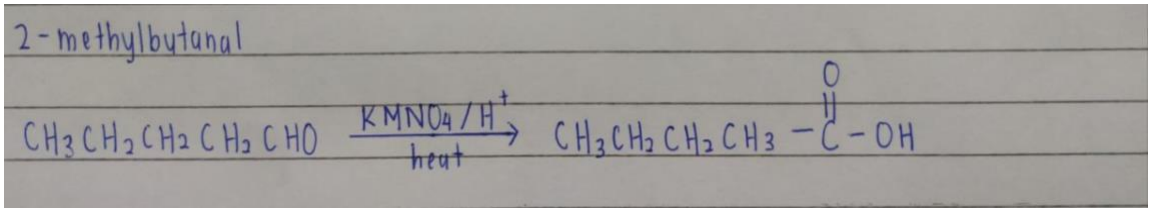
Answer:

2-butanone will turn into aldehyde while the 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 Tollen's Reagent**.**



2-methylbutanal will undergo oxidation when react with KMNO4.



1.9 DISCUSSION

a. Fehling's test

$$Reaction\ when\ aldehyde\ reacts\ with\ fehling's\ reagent:$$

$$R - CHO + 2Cu^{2+} + 5OH^{-} \rightarrow R - COO + Cu_2O + 3H_2O$$

In this experiment, only aliphatic aldehyde shows positive result as it can turns the blue colour of Fehling's reagent even after heating into brick-red precipitate in solution was formed. Aromatic aldehydes did not react with Fehling's reagent as it contains benzene ring. Due to resonance, it becomes a strong bond and oxidizing agent that cuprum unable to oxidize it.

Both simple ketone and cyclic ketone did not undergo Fehling's test because they cannot be oxidized as there are no hydrocarbon bond that attach to carbon that contains double bond in ketone. (Oxidation of Aldehydes and Ketone, 2019)

b. Schiff's test

A Schiff test are used for testing aldehydes and ketones. Aliphatic aldehydes restore the pink immediately, whereas aromatic ketones have no effect on the reagent. Aromatic aldehydes restore the colour slowly.

For this experiment, 4 test tube with different unknown in each test tube labelled as A, B, C, D. A few drops of schifff reagent has been added to each test tube. Booth test tubes are shaken gently. For test tube A, reagent color change into dark purple. It show that aliphatic aldehyde reacts with Schiff reagent. Test tube B change the reagent color into pink color. Theritically, it show the reaction of aromayic aldehyde with schiff reagent. For test tube C and test tube D, the reagent colour remain unchange.This shows that these two test tube contain ketone which are they cannot react with schiff reagent as they cannot oxidized like aldehyde. (Identification of an Unknown- Alcohols, Aldehydes, and Ketones)

c. Iodoform test

For the result in iodoform test, unknown C shown the positive test. On the other hand, for 3 more unknowns which are unknown A, B and D just form from colourless to yellow which mean, the 3 unknowns are negative test. In this iodoform test, the positive test will form a yellow precipitate like shown by unknown C. This is because,

if an alkaline solution of iodine is warmed with an organic compound and a yellow precipitate of triiodomethane is produced. So, scientist can relate that unknown C may be ethanal from aldehyde, ethanol, methyl ketones or any methyl ketones group that have CH3. Furthermore, unknown A, B and D may be other than unknown C like, but 3-pentanone and diphenylmethanone.

d. Tollen's test

In this experiment, aliphatic aldehyde and aromatic aldehyde show a positive result. A positive test with Tollen's reagent is indicated by the precipitation of elemental silver, often producing a characteristic silver mirror on the inner surface of the reaction vessel. Since Aldehydes have the presence of hydrogen atoms, it makes it easier for it to be oxidized, hence forming the mirror-like image on the test tubes. This can be seen in acetaldehyde as well as proprion aldehyde as the have formed the silver substance. These chemicals have therefore tested positive to Tollen's Reagent. Next, the results for simple ketone and cyclic ketone are remains unchanged which show a negative result. There was no change to the colourless solution due to ketones being less susceptible to oxidation. This test shows aldehydes are more readily oxidised compared to ketones which is due to the carbonyl-containing carbon in aldehydes having an attach hydrogen. (Clark, 2019)

The difference between an aldehyde and a ketone is the presence of a hydrogen atom attached to the carbon-oxygen double bond in the aldehyde. Ketones do not have that hydrogen. The presence of that hydrogen atom makes aldehydes very easy to oxidize. Aldehydes reduce the diamminesilver (I) ion to metallic silver. Because the solution is alkaline, the aldehyde itself is oxidized to a salt of the corresponding carboxylic acid. The electron half equation for the reduction of the diamminesilver(I) ions to silver is:

$$Ag(NH3)+2+e- \rightarrow Ag+2NH3(6)(6)Ag(NH3)2+e- \rightarrow Ag+2NH3$$

Then, the combination with the half-equation for the oxidation of an aldehyde under alkaline conditions:

$$RCHO+3OH- \rightarrow RCOO-+2H2O+2e-(7)(7)RCHO+3OH- \rightarrow RCOO-+2H2O+2e-$$

The overall equation:

$$2Ag(NH3)+2+RCHO+3OH- \rightarrow 2Ag+RCOO-+4NH3+2H2O$$

e. Brady's test

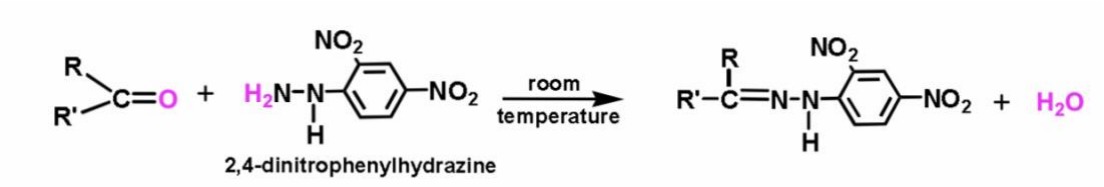


Figure1: General equation for aldehyde react with 2,4-DNPH

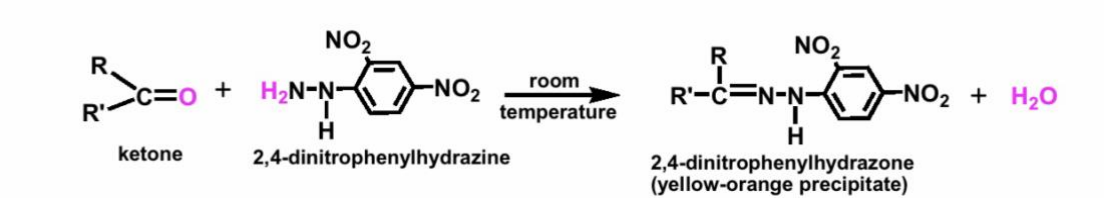


Figure 2: General equation for ketone react with 2,4-DNPH

In this experiment, all compounds in the test tubes yields positive result when they react with 2,4-dinitrophenylhydrazine. All compound formed yellow precipitate when Brady's reagent was added. This experiment can detect the presence of C=O found in the aldehyde and ketone. It also can be as a confirmation for the unknown solution to know is it either aldehyde or ketone or other solutions contain in it the test tubes. (What is 2,4-dinitrophenylhydrazine?- Structure & Hazards, 2017)

1.10 CONCLUSION

In conclusion, aldehydes and ketones are utilized in many mechanisms and reagents. The current experiment utilized information known about aldehydes and ketones to identify an unknown compound. The schiff test, the Tollens test, iodoform test and Fehling test was utilized to identify the presence of an aldehyde or ketone, respectfully, in the unknown compound. As conclusion unknown solution in test tube A and B can be identified as aliphatic aldehyde and aromatic aldehyde. For test tube C and D can be identified as simple ketone and cylic ketone.

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