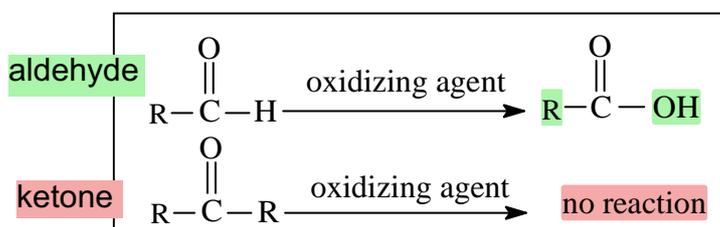


# ALDEHYDES AND KETONES

## Classification, Tests and Derivatives

### INTRODUCTION

The carbonyl group is common to both aldehydes and ketones, and as a result, both classes of compounds react similarly with many reagents. 2,4-Dinitrophenylhydrazine is commonly used to test for both types of compounds. However a distinguishing behavior of aldehydes is their reaction with mild oxidizing agents which oxidize them to carboxylic acids while ketones, which are more difficult to oxidize, remains unchanged.



الألدهايد يتأكسد الى حمض كربوكسيلي اما الكيتون لا يتأكسد

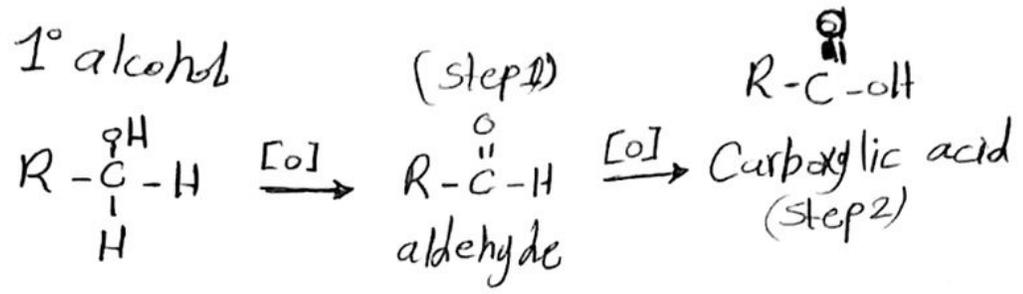
معظم الاختبارات التي تميز بين الكحول والألدهايد تعتمد على اختلاف سلوكهم مع المؤكسدات

Several laboratory tests that distinguish between aldehydes and ketones, therefore, take advantage of this difference in behavior towards oxidants. One of these is *Tollens'* silver mirror test, in which a silver ammonia complex ion is reduced, by aldehydes, to metallic silver. *Fehling's* and *Benedict's* solutions are also distinguishing reagents where the Cu(II) ion, complexed to tartarate or citrate respectively, is reduced to red cuprous oxide (Cu<sub>2</sub>O) by aldehydes but not ketones.

Carbonyl compounds (aldehydes and ketones) are conveniently identified through a number of easily prepared derivatives. These include oximes, phenylhydrazones, 2,4-dinitrophenylhydrazones and semicarbazones. These derivatives are ideal because they are easily purified, crystalline solids with sharp melting points.

The mechanism of formation of these closely related derivatives involves a typical nucleophilic addition at the carbonyl carbon followed by elimination of a water molecule.

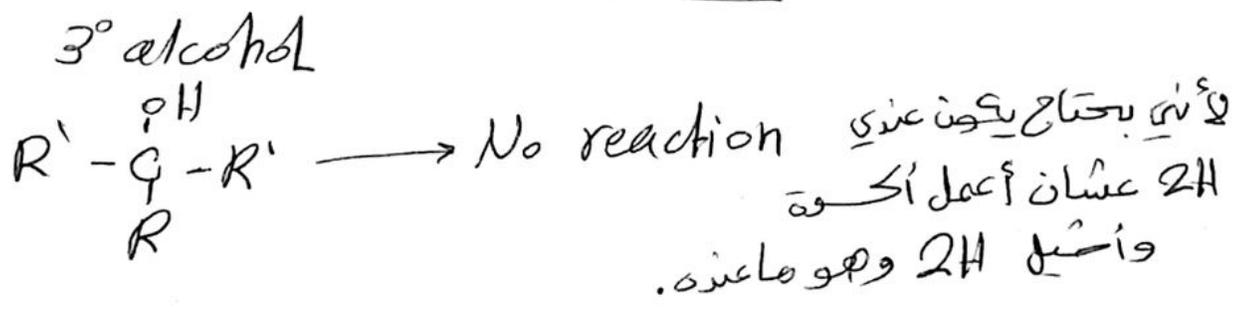
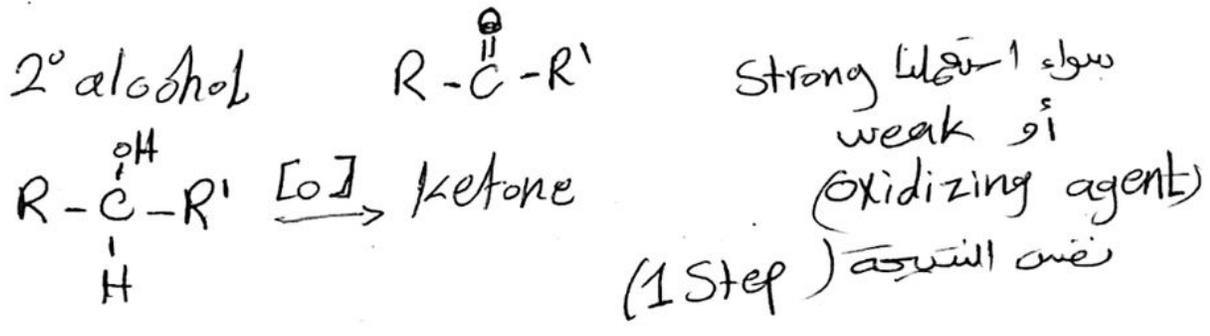
[O] oxidation



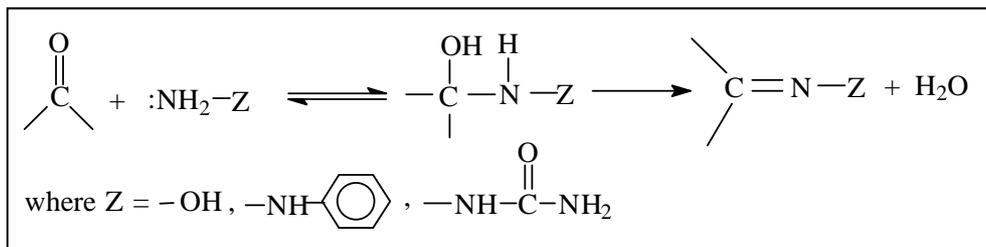
weak oxidizing agent)  $\leftarrow$  عند إجراء 2 Steps \*

Strong oxidizing agent  $\leftarrow$  \* أو لو في حال استعمال

Carboxylic acid  $\left[ \begin{array}{l} K_2Cr_2O_7 \text{ في} \\ H_2Cr_2O_4 \\ KMnO_4 \end{array} \right]$   
 بدون ما يدخل بمرحلة الaldehyde  
 سكون مباشرة ال 1° إلى



لا حظ: في حال إجراء الaldehyde مرة أخرى  $\ominus$   
 No rxn  $\leftarrow$  ketone  $\oplus$  Carboxylic acid



For

further structural identification of methyl carbonyl compounds, the iodoform reaction, using iodine and aqueous sodium hydroxide is used. Compounds containing the CH<sub>3</sub>CO group give a bright yellow precipitate of CHI<sub>3</sub> (*iodoform*).

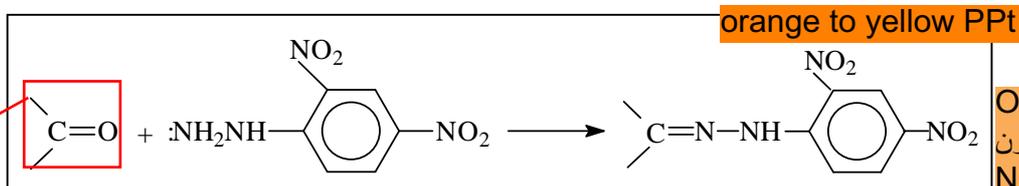
## EXPERIMENTAL

<b>MATERIALS NEEDED</b>	<p><u>Glassware:</u> 4 test tubes, Erlenmeyer flask (50 mL), ice bath, graduated cylinder (10 mL), Buchner funnel, filter flask, melting point apparatus.</p> <p><u>Chemicals:</u> 15 mL Tollens' reagent, 0.5 mL each of: formaldehyde, benzaldehyde, acetone, 2-propanol, 2-pentanone, 3-pentanone, 15 mL Fehling's or Benedict's solution, 12 mL sodium hydroxide(5%), 40 mL iodoform reagent, 1.0 g hydroxylamine hydrochloride, 3 g sodium acetate, 2.3 mL cyclohexanone, 30 mL petroleum ether, 5.0 mL phenylhydrazine reagent, 50 mL ethanol, 16 mL 2,4-dinitrophenylhydrazine reagent, 1.0 g semicarbazide hydrochloride and 1.0 g unknown.</p>
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### I. TESTS AND DERIVATIVES

هذا التفاعل يميز الكيتون والالدهايد معاً عن الكحول

#### 1. 2,4-Dinitrophenylhydrazine Test



ketone or aldehyde

إذا عمل راسب Orange يكون عندي الدهايد او كيتون ولو كان Negative يكون كحول او فينول

**Procedure.** To 2 mL of ethanol in a test tube add 5 drops of acetone and mix. Add 2 mL of 2,4-dinitrophenylhydrazine reagent shake, and observe the result. Repeat with benzaldehyde and cyclohexanone.



#### 2. Tollens' Silver Mirror Test

يتكون مرآة فضية بالقاع (positive with aldehyde)  
لا يتكون مرآة (negative with ketone)

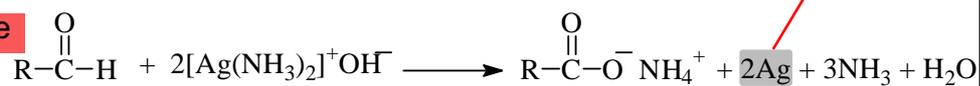
formaldehyde is very fast formation silver mirror

وكلما زادت مجموعة ال يكون ابطاً مثل

propanal /butanal/pentanal

ترسب الفضة هو سبب اللون الفضي

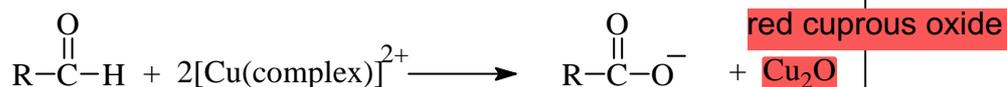
aldehyde



**Procedure.** Place 5 mL of freshly prepared *Tollens'* reagent in each of three clean test tubes and add 3-4 drops of formaldehyde benzaldehyde, or acetone solution. Shake the tubes vigorously and allow them to stand for 10 minutes. If no reaction occurs place the tubes in a hot water bath (50°C) for a few minutes.

### 3. *Fehling's and Benedict's Tests*

الالدهايد يتحول من blue الى dark red الكيتون يبقى blue



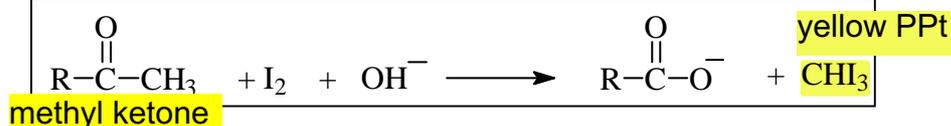
red cuprous oxide



**Procedure.** Place 5 mL of either *Benedict's* reagent or freshly prepared *Fehling's* reagent in a clean test tube and add a few drops of formaldehyde solution. Place the test tube in a beaker of boiling water and observe any color changes that occur within 15-20 minutes. Record your observations. Repeat with benzaldehyde and acetone.

### 4. *The Iodoform Test*

هذا الاختبار يعطي + مع methyl (كيتون والالدهايد والكحول). يعني اللي فيهم CH3 طرفية

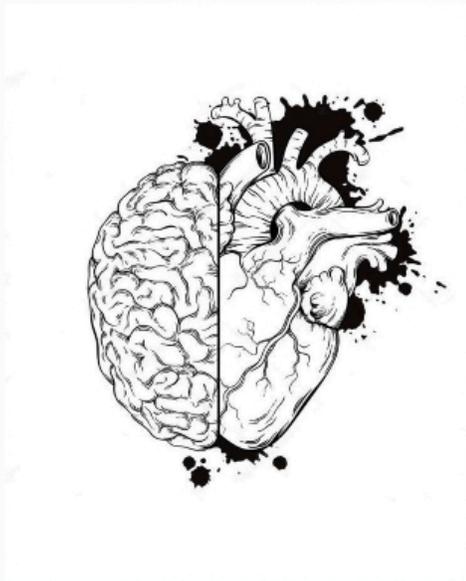


yellow Ppt

methyl ketone



**Procedure.** To 10 drops of acetone in 3 mL of 5% sodium hydroxide add iodine solution and shake until the color of iodine nearly persists (about 10 mL of iodine solution). At this stage the yellow precipitate of iodoform should have formed. Repeat the test with 2-propanol, 2-pentanone, and 3-pentanone. Record your



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