ALCOHOLS

Alcohols Organic compounds contain one or more OH groups connected to a saturated Carbon.

Phenols C_6H_5OH Organic compounds contain an OH group connected to a carbon in a benzene ring.

Alcohols are polar molecules causing to have a partial positive and partial negative charge.

Hydrogen bonding occurs between molecules have a hydrogen atom attached to the very electronegative elements like oxygen or nitrogen.

Naming alcohols

In IUPAC name, the -e in alkane name is replaced with -ol.

The general formula of alcohols CnH2n+1 OH

Examples:

CH_4 methane CH_3OH methanol (methyl alcohol)

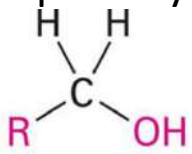
CH_3CH_3 ethane CH_3CH_2OH ethanol (ethyl alcohol)

$CH_3CH_2CH_3$ propane $CH_3CH_2CH_2OH$ propanol (propyl alcohol)

Classification Alcohols

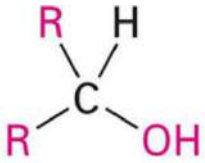
To classify alcohols, we look at the carbon atom R bonded to the hydroxyl group**.**

1-primary alcohols (1°) = 1 carbon atom (1R)



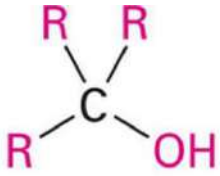
Primary

2-secondary alcohols (2°) = 2 carbon atom (2 R)



Secondary

3-tertiary alcohols (3°) = 3 carbon atoms (3 R)

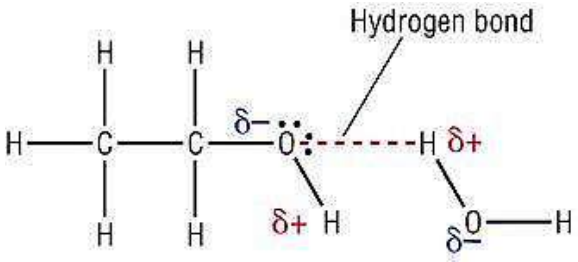


Tertiary

Physical Properties of Alcohols

1-Alcohols with short carbon chains are soluble in water.

Because hydrogen bonds form between the -OH group in alcohols and water molecules.



2-Because alcohols hydrogen bond to each other, they have higher boiling and melting points than hydrocarbons.

Chemical Properties of Alcohols

1-Biological reaction of ethanol

Ethanol is oxidized in the body to acetic acid, using an enzyme produced by the liver(ADH). The actual oxidizing agent is nicotinamide adenine dinucleotide (NAD+).

CH_3CH_2OH + NAD+ -- ----→ CH_3CHO + NADH + H+

CH_3CHO + NAD+ ------→ CH_3COOH + NADH + H+

2-Alcohols get reacts with Phosphorus halide and prepare haloalkanes.

$CH_3CH_2OH+PCl_5 \rightarrow CH_3CH_2-Cl+POCl_3+HCl$

3-Reaction with Grignard reagent – Alcohols get react with Grignard reagents in order to produce hydrocarbons.

$CH_3OH+C_2H_5MgBr \rightarrow C_2H_6+CH_3OMgBr$

كلية الطوسي الجامعة قسم تقنيات المختبرات الطبية

الكيمياء العامة العملي /مرحلة اولى

التجربة الثالثة

1-Title: Identification of Alcohols

2-**Aim**: In this experiment you are going to do a series of tests in order to determine whether or not an alcohol is a primary (1°), secondary (2°) or tertiary (3°) alcohol.

3-Theory: Oxidation of primary alcohols produce an aldehyde then carboxylic acid while secondary alcohols produce ketone and tertiary alcohol no reaction. with a secondary alcohol and with a tertiary alcohol Lucas reagent give emulsion while primary alcohol no reaction. The experiment has three parts. First, you will practice the chemical test using known alcohols. The tests on the three known alcohols can be done at the same time.

4- Apparatus and Chemicals:

Jones reagent, Lucas reagent Test tubes, Tertiary alcohol,

2-propanol, Ethnol

5-Procedure:

1-Dissolve 10 mg or 2 drops of the unknown in 1 mL of pure acetone in a test tube and add to the solution 1 small drop of Ethnol (Chromic oxide in sulfuric acid). A positive test is marked by the formation of a green color within 15 seconds upon addition of the orange-yellow reagent to a primary or secondary alcohol. But tertiary alcohols do not.

$CH_3CH_2OH + Cr^{+6} \longrightarrow Cr^{+3} + CH_3CHO \longrightarrow CH_3COOH$

Ethanol Ethanal acetic acid

$CH_3CHOHCH_3 + Cr^{+6} \longrightarrow Cr^{+3} + CH_3COCH_3$

2-propanol propanone

$R_3COH + Cr^{+6} \longrightarrow$ No oxidation

2- To 0.2 mL or 0.2 g of the unknown in a test tube add 2 mL of the Lucas reagent at room temperature.

Note the time required for the formation of the alkyl chloride, which appears as an insoluble layer or emulsion. Appearance of a cloudy second layer or emulsion

3^o alcohols: immediate to 2-3 minutes

2^o alcohols: 5 -10 minutes

1^o alcohols: no reaction

$R_3COH + HCl + ZnCl_2 \longrightarrow R_3CCl$ (2-3 minute)

Tertiary alcohol

$CH_3CHOHCH_3 + HCl + ZnCl_2 \longrightarrow CH_3CHClCH_3$ (5-10 minute)

2-propanol 2-Chloro propane

$CH_3CH_2OH + HCl + ZnCl_2 \longrightarrow$ No reaction

Ethanol

1- Title: Identification of aldehydes and ketones

2-Aim:

To identify the presence of aldehydes or ketones functional group in the given organic compound.

3-Theory:

Aldehydes and ketones constitute an important class of organic compounds containing the **carbonyl group.** Aldehyde has the structure RCH(=O) while a ketone has the structure of R2C(=O), where R may be an alkyl, alkenyl, alkynyl or aryl group.

Identification of aldehydes and ketones is based on two types of reactions, **addition reaction** to the double bond and **oxidation reaction**.

4- Chemical and Apparatus:

Fehling's solutions A, Fehling's solutions B

sodium nitroprusside, sodium bisulphite, Test tubes, Test tube holder, Beaker

5-Procedure for test of aldehydes and ketones:

(a) - Fehling's Test:

Fehling's solution is prepared by mixing equal amounts of Fehling's A and Fehling's B solution.

- Take the given organic compound in a clean test tube.

- Add Fehling's solution to it and heat the solution gently.

- If a brick-red precipitate appears, then the presence of aldehyde is confirmed.

$$\mathbf{RCHO + 2\ Cu^{2+} + 5\ OH^- \rightarrow RCOO^- + Cu_2O \downarrow + 3\ H_2O}$$

Aldehyde brick-red precipitate

(b)- Sodium Nitroprusside Test:

Ketone reacts with alkali and forms an anion which further reacts with sodium nitroprusside and forms red color complex ion.

-Dissolve sodium nitroprusside in distilled water in a clean test tube.

-Add 1ml of the given organic compound to be tested.

-Shake well and add sodium hydroxide solution dropwise.

$CH_3COCH_3 + OH^- \rightarrow CH_3COCH_2^- + H_2O$

Acetone

$[Fe(CN)_5NO]^{2-} + CH_3COCH_2^- \rightarrow [Fe(CN)_5NO.CH_3COCH_2]^{3-}$

Nitroprusside ion Red color complex ion

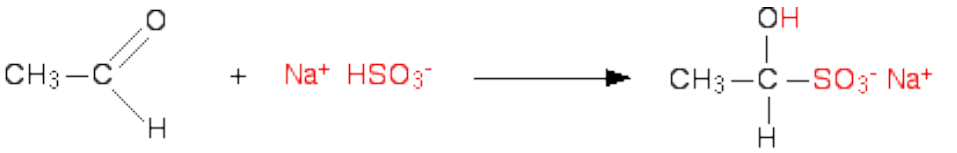
(c)- Sodium Bisulphite ($NaHSO_3$) Test:

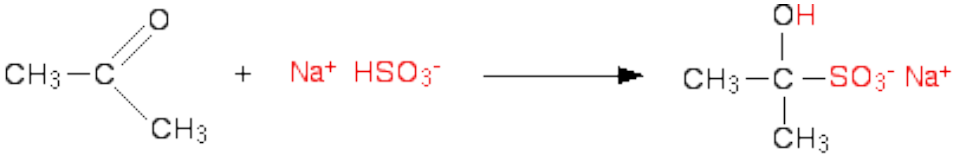
-Take a saturated solution of sodium bisulphite in a clean test tube.

-Add 1ml of the given organic compound to be tested.

-Shake well and leave it for 15-20 minutes.

-If there is a formation of white precipitate, then the presence of the carbonyl group is confirmed.





1-Title: Identification of Acetic acid

2- Aim:

To identify the presence of carboxylic functional group in a given organic compound.

3-Theory:

Carboxylic acid is an organic acid that contains a carboxyl group (-COOH) attached to an R-group. The general formula of a carboxylic acid is R−COOH. Carboxylic acids have a tendency to donate protons and act as acids. Due to the presence of carbonyl group (C = O) and hydroxyl group, the name carboxyl is addressed to carboxylic acid.

In mitochondria enzymatic reaction, CoA synthetase (ACS) in the presence of (ATP) and (CoA) converts acetic acid (acetate) into Acetyl-CoA

$$\text{Acetate} + \text{ATP} + \text{CoA} \xrightarrow{\text{(ACS)}} \text{Acetyl-CoA} + \text{AMP} + \text{pyrophosphate(ppi)}$$

4- Materials Required:

Blue litmus paper, Sodium bicarbonate, methyl alcohol, concentrated Sulphuric acid, Test tube, holders, Beaker, Glass rod, Stirrer

5- Procedure:

A-Litmus Test:

Add a drop of given organic compound on blue litmus paper.

If the colour of **blue** litmus changes to **red** that is presence of carboxylic acid. The hydroxyl group present in -COOH is far more acidic than in alcohol.

$CH_3COOH + H_2O \rightarrow CH_3COO^- + H_3O^+$

Acetic acid Acetate

B-Sodium Bicarbonate Test:

Prepare a saturated solution of sodium bicarbonate by dissolving sodium bicarbonate in 1ml of water. Add the given organic compound to the saturated solution of sodium bicarbonate solution. Shake the solution well. If there is an evolution of brisk effervescence then it indicates the presence of carboxylic acid.

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2\uparrow$

Acetic acid sodium acetate

C-Ester Test:

Mix the given compound with methanol and concentrated sulphuric acid. Heat and Pour the reaction mixture into a beaker carefully containing water. The sweet smelling substance is sensed, then it indicates the presence of acid. This reaction is known as esterification.

$CH_3COOH + CH_3OH + H_2SO_4 \rightarrow CH_3COOCH_3 + H_2O$

Acetic acid methanol methyl acetate(Ester)

CARBOHYDRATES

Biochemistry

Biochemistry is the study of the chemical processes and reactions that occur within living organisms.

Biochemistry is essential for understanding the **structure** and **function of biomolecules** like proteins, carbohydrates, lipids, and nucleic acids.

Functions of carbohydrates

Carbohydrates have several **important functions** in the human body, including:

1-Energy Source: Carbohydrates are the body's **primary source of energy**. They are broken down into glucose, which is then used to produce **ATP**.

2-Energy Storage: Excess glucose in the bloodstream is stored as **glycogen** in the liver and muscles.

3-Structural Support: Carbohydrates are important components of **cell membranes** and **connective tissues**.

4-Signal Transduction: Carbohydrates on the **surface of cells** act as **signaling molecules** allowing cells to communicate with each other.

Classification of carbohydrates

Carbohydrates are organic molecules contain carbon, hydrogen, and oxygen atoms, with the general formula $(CH_2O)_n$, where "n" represents the number of carbon atoms in the molecule.

Carbohydrates can be classified into different categories based on the number of sugar units they contain.

1-Monosaccharides, are the simplest form and cannot be broken down into smaller units such as glucose.

2- Disaccharides, consist of two monosaccharides joined together by a glycosidic bond such as sucrose and lactose.

3-Polysaccharides, consist of long chains of monosaccharide units joined together by glycosidic bonds. such as starch, glycogen, and cellulose.

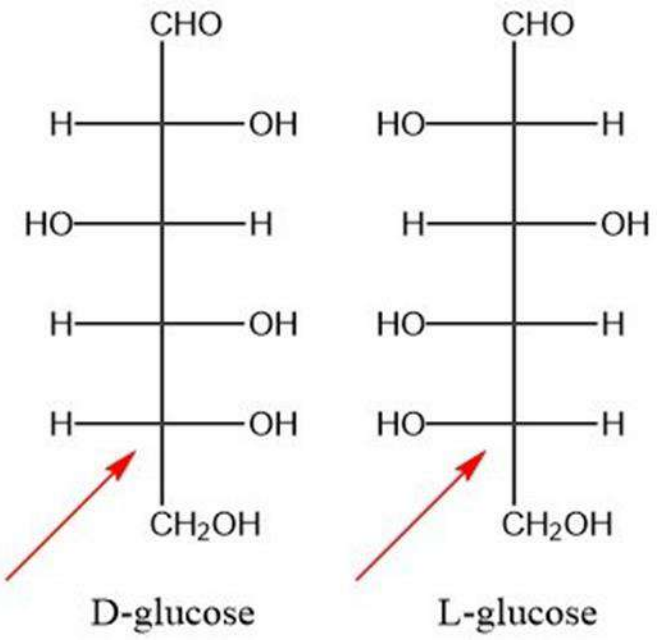
Structure of carbohydrates

A-Fischer Projections

The Fischer projection (**straight chain**) makes it appear that the molecule is flat but it is a three-dimensional molecule.

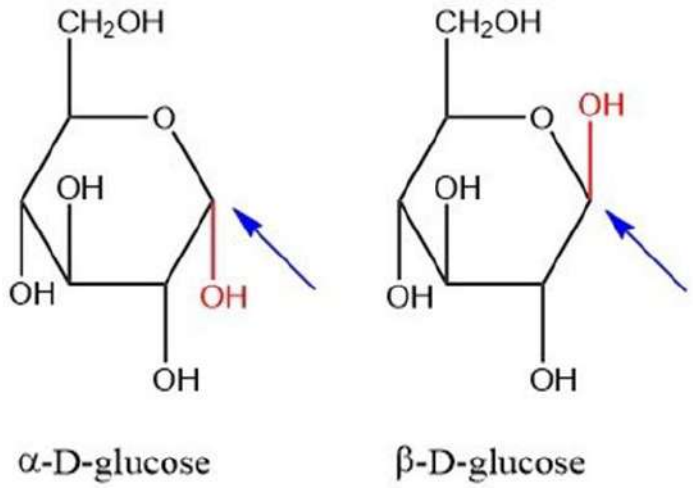
Each carbohydrate molecule has an **enantiomer** as the D- and L- of the compound. The designation is based on the orientation of the −OH group on the **chiral carbon** farthest from the aldehyde or ketone. D-sugar is the sugar with the −OH group on the right. L-sugar is the sugar with the −OH group on the left.

D-glucose and L-glucose are mirror images of one another.



B-Haworth Structures

When the cyclic monosaccharide forms, there are two forms, called α (alpha) and β (beta). The α form occurs when the −OH group on the **anomeric carbon** is below. The β form occurs when the −OH group on the **anomeric carbon** is pointing up. The cyclic forms of carbohydrates can interconvert between the alpha and beta forms.



Complete name of sugar includes: anomer, enantiomer, sugar

Eg: α-D-Glucose, β-D-Glucose

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الكيمياء العامة العملي / المرحلة الاولى 2023 /2022

التجربة الخامسة

Title: Determination of glucose in blood &urine

Theory: Glucose is a monosaccharide. It is central molecule in carbohydrate metabolism. Stored as glycogen in liver and skeletal muscle**.**

Practical methods:

Blood is collect in fluoride containing vial because Fluoride inhibit glycolysis.

For glucose estimation from urine, add 5ml glacial acetic acid to inhibit bacterial growth.

1-Method for determination of glucose in the urine

Benedict's Test

This is a very simple and effective method of the amount of glucose in the urine.

Procedure:

5 ml of Benedict's reagent + 8 to 10 drops of urine Boiling the mixture & cool down it.

If the color of the solution is **blue** this mean sugar absent. If the color of the solution is Brick red this mean more sugar.

The following is the chemical reaction:

$$R\text{-}CHO + 2Cu^{+2} + 2H_2O \rightarrow R\text{-}COOH + \mathbf{Cu_2O}\downarrow + 4H^+$$

Glucose Gluconic acid

2- Condensation reaction (O-toluidine method)

Materials:

O-toluidine reagent, 10%TCA, glucose standard sol(0.1mg/ml).

O-toluidine reacts in hot glacial acetic acid with the terminal aldehyde group of glucose to produce a **green colored complex**.

The condensation product measured in **photometer** at **λ** max 630nm.

R-CHO + O- toluidine ⟹ **green color complex**

3-Glucose dehydrogenase (GDH) Method

GDH catalyzes the oxidation of blood glucose in the presence of cofactors like NAD which produces NADH that can be measured by **electrochemical method**.

$$R\text{-}CHO + NAD^{+} \xrightarrow{GDH} C_6H_{10}O_6 + NADH + H^{+}$$

D-glucose Gluconolactone

Lipids

Lipids are fatty, waxy, or oily compounds that are soluble in organic solvents and insoluble in water.

Fatty acids are hydrocarbon chains that end with carboxylic acid groups.

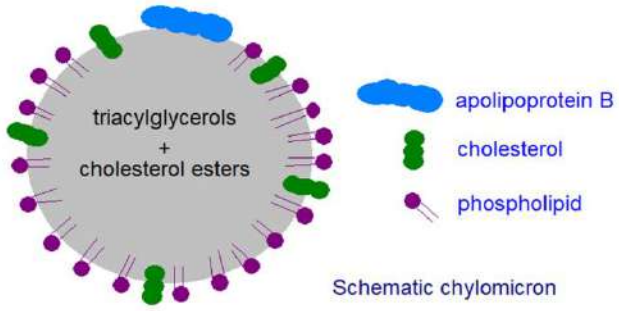
The **general formula** of fatty acids is **$CH_3(CH_2)nCOOH$**

n(2-28 carbon atoms**)** and always has an **even number.**

Function of lipids

- Triglycerides store energy.
- provide insulation to cells.
- aid in the absorption of fat-soluble vitamins.

chylomicrons a droplet of fat present in the blood or lymph after absorption from the small intestine.



Lipoproteins are lipid-protein complexes that allow all lipids to be transported throughout the body by the circulatory system.

VLDLs are **triglyceride-rich particles** made in the **liver**.

LDL transports **mos**t of the cholesterol in the blood and is considered “bad cholesterol”.

HDL particles are cholesterol and phospholipid-rich and is considered “good cholesterol”.

Determination the types of lipids in the blood

Cholesterol levels are usually steady, triglyceride levels vary from day to day and rise after meals. Therefore, a blood sample taken for lipid testing should occur after a 12-hour fasting period, which allows the clearance of chylomicrons from the blood. For more accurate results, patients should not take any medications that could change blood lipid levels or take the test during times of stress or illness.

Triglyceride formation reaction can be written as follows: