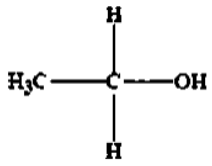
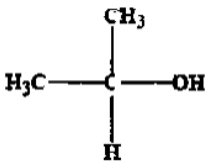
Alcohols

Alcohols are organic molecules that contain a hydroxyl (OH) group. Alcohols can be classified as primary, secondary, or tertiary. This classification is based on whether the alcohol carbon is attached to one, two, or three alkyl groups. This classification is important, because the different classes of alcohols react differently.

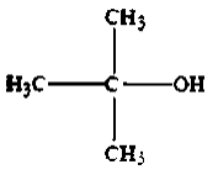
Examples of the classes of alcohols are shown below. Because alcohols contain an –OH group, they are able to form hydrogen bonds to one another.



A primary alcohol



A secondary alcohol



A tertiary alcohol

They therefore have high boiling points. Alcohols can also form hydrogen bonds with water, so small alcohols are water-soluble.

The smallest alcohols, methanol (CH_3OH) and ethanol (CH_3CH_2OH), are completely soluble in water in any proportions. As the hydrocarbon part of an alcohol gets larger, the alcohol becomes less water soluble and more soluble in nonpolar solvents.

Aim: Identification of methanol, ethanol and glycerin and differentiating between them.

Identification of methyl alcohol (Methanol)

CH_3OH

Physical properties

1) Color: –

2) State: –

3) Miscibility: –

4) Effect of litmus paper: –

Chemical properties

Experiment	Observation	Results
1) $KMnO_4$ test 0.5 ml of methanol + drops of $KMnO_4$ + drops of conc. H_2SO_4. Heat on water bath	Disappearance of violet color	$MnSO_4$
2) $K_2Cr_2O_7$ test 0.5 ml of methanol + drops of $K_2Cr_2O_7$ + drops of conc. H_2SO_4. Heat on water bath	Change color to green	Cr^{3+}
3) Iodoform test 0.5 ml of methanol + 0.5 ml of Tollen's reagent then heat on water bath	No yellow precipitate	No CHI_3 formed
4) Esterification test 0.5 ml of methanol + 1 ml conc. H_2SO_4 + 1 ml salicylic acid. Heated the mixture for five minutes.	Fruity odor	Methyl salicylate

Aldehyde

Identification of formaldehyde (methanal)

HCHO

Physical properties

1) color: colorless

2) state: -

3) Miscibility: -

4) effect of litmus paper: -

Chemical properties

Experiment	Observation	Results
① Fehling test Formaldehyde solution + 2 ml of Fehling (A+B) reagent + heating	Red p.p.t	The presence of an aldehyde group ($Cu^{2+} \rightarrow Cu^{+}$ red ppt)
② Tollen's test 1 ml of formaldehyde + 2 ml of Tollen's reagent then heat on water bath	Black or silver mirror	Aldehyde presence (Ag formed)
③ Resorcinol test 1 ml of formaldehyde + 2 ml of resorcinol and drop by drop concentrated H_2SO_4	A red or reddish violet color	Formaldehyde present

Ketone

Identification of acetone (propanone)

CH_3COCH_3

Physical properties

1) color: -

2) state: -

3) Miscibility: -

4) effect of litmus paper: -

Chemical properties

Experiment	Observation	Results
1) Iodoform test 1 ml of acetone + 5 ml of iodine reagent + dropwise of NaOH	yellow precipitate	CHI_3 formed
2) Nitroprusside test 1 ml of acetone + 0.5 ml of $Na_2[Fe(CN)_5NO]$ + drops of NaOH	red color	$Na_2[Fe(CN)_5NOCH_2COCH_3]$
3) Tollen's test 1 ml of acetone + 2 ml of Tollen's reagent then Heat on water bath	No black or silver mirror	No Ag precipitate

Questions & Notes

- Why the Iodoform test gives yellow ppt with ketone (acetone) in cold?
  → Because the acetone (ketones) don't have α-hydrogen.
- Why the Tollen's test not give black or silver mirror with ketone (acetone)?
  → Because the ketone cannot be oxidized (ketone has no –H).

Identification of acetaldehyde (ethanal)

CH_3CHO

Physical properties

1) color: -

2) state: -

3) Miscibility: -

4) effect of litmus paper: -

Chemical properties

Experiment	Observation	Results
1) Fehling test 1 ml formaldehyde solution + 2 ml Fehling (A+B) reagent + heating	Red color ppt	The presence of an aldehyde group
2) Tollen's test 1 ml of acetaldehyde + 2 ml of Tollen's reagent then Heat on water bath	Black or silver mirror	Ag
3) Iodoform test 1 ml of acetaldehyde + 5 ml of iodine reagent + dropwise of NaOH + heating	Yellow precipitate	CHI_3 formed
4) Resorcinol test 1 ml of acetaldehyde + 2 ml of resorcinol and drop by drop concentrated sulfuric acid	Brown color ring	Acetaldehyde present

Aldehydes

Aldehydes are compounds of the general formula **RCHO**; Ketones are compounds of the general formula **R_2CO**.

The aldehyde, formaldehyde, R is hydrogen. Both aldehydes and ketones contain the carbonyl group **CO**, and are often referred to collectively as carbonyl compounds. It is this carbonyl group that largely determines the chief chemical and physical properties of aldehydes and ketones.

Aim:

Identification of **aldehydic** and **ketonic** functional groups and differentiating between both groups destingshing.
