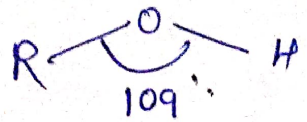
Alcohols

→ Alcohol is any organic compound in ≤ the hydroxyl functional group (-OH) is bound to a saturated carbon atom.



Qualitative test

→ These test are used to identify the presence of alcohol in a particular solution.

⇒ following types of test.

(1) Sodium metal test
(2) Ester test
(3) Ceric ammonium nitrate test
(4) Acetyl chloride test
(5) Iodoform test

(1) Sodium metal test-

→ Alcohol react ∈ dry Na metal & liberate H_2 gas that can be observed in form of effervescence.

$$2R-OH + 2Na \longrightarrow 2R-O^-Na^+ + H_2\uparrow$$

$$2CH_3OH + 2Na \longrightarrow 2CH_3-O^-Na^+ + H_2\uparrow$$

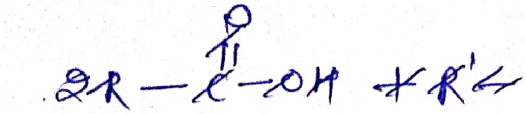
(Sod. methoxide)

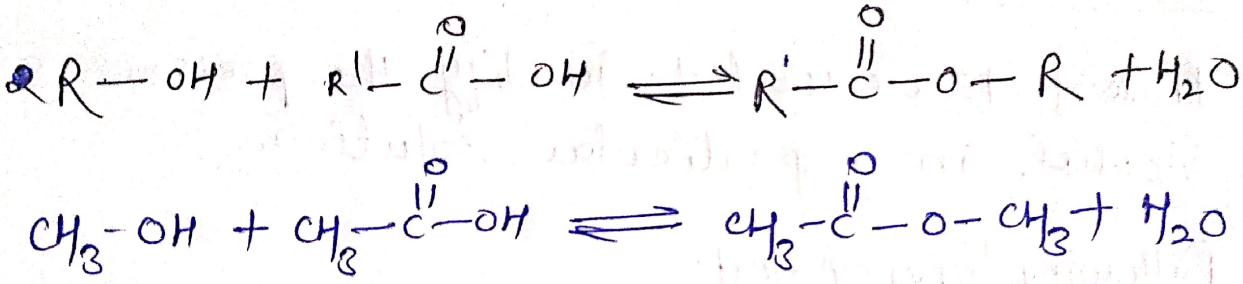
(2) Ester test

→ Alcohol react ε-COOH to form fruity smelling compound called "ester".

→ This reaction is called esterification.

→ catalysed by conⁿ H_2SO_4





$CH_3-OH + CH_3-C(=O)-OH \rightleftharpoons CH_3-C(=O)-O-CH_3 + H_2O$

(Methyl acetate)

(3) Ceric Ammonium nitrate test

Alcohols react ε ceric ammonium nitrate to form a red coloured **Alkoxy cerium** compound.

$2R-OH + (NH_4)_2Ce(NO_3)_6 \longrightarrow (R-OH)_2Ce(NO_3)_4 + 2NH_4NO_3$

Alcohol — ceric amm. nitrate — Alkoxy cerium compound IV (Pink/red coloured)

$2CH_3-OH + (NH_4)_2Ce(NO_3)_6 \longrightarrow (CH_3OH)_2Ce(NO_3)_4 + 2NH_4NO_3$

Methyl alcohol — Methoxy cerium(IV) compound

④ Acetyl chloride test

* Alcohol react ē acetyl chloride to form ester and give out HCl gas.
* HCl gas when react ē NH_4OH give white fumes.

$$R-OH + CH_3-\overset{\overset{O}{\|}}{C}-Cl \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-O-R + HCl\uparrow$$

alcohol — Acetyl chloride — Ester — Hydrogen chloride gas

$$HCl + NH_4OH \longrightarrow \underline{NH_4Cl} + H_2O$$

↓ white fumes

⑤ Iodoform test

→ This test is given by acetaldehyde, all methyl ketones & all alcohol containing $CH_3\text{-}CH\text{-}OH$ group.

→ When alcohol react ē/warmed ē NaOH solution and iodine → A yellow precipitate forms.

$$CH_3-\underset{OH}{\overset{|}{CH}}-CH_3 + I_2 + 2NaOH \longrightarrow CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + 2NaI + 2H_2O$$

(Propanol) (acetone)

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + 3I_2 + 4NaOH \longrightarrow \underline{CHI_3} + CH_3COONa + 3NaI + H_2O$$

Acetone — ↓ Iodoform

Test to differentiate Primary, secondary and tertiary alcohol.

1. Lucas test
2. Victor Meyer test

1. Lucas test

→ Lucas reagent is anhydrous $ZnCl_2$ in conⁿ hydrochloric acid.

→ It is based on the difference in reactivity of alcohol & hydrogen halide.

→ It follows the SN1 reaction.

1. Test for Primary Alcohol

→ When Lucas reagent is added to 1° alcohol, there is no change observed in the solution, rather it remain colourless.

→ The solution is then heated for 30-45 minute and an oily layer is formed.

e.g.

$$C_2H_5OH + HCl \longrightarrow C_2H_5Cl + H_2O$$

(No turbidity observed)

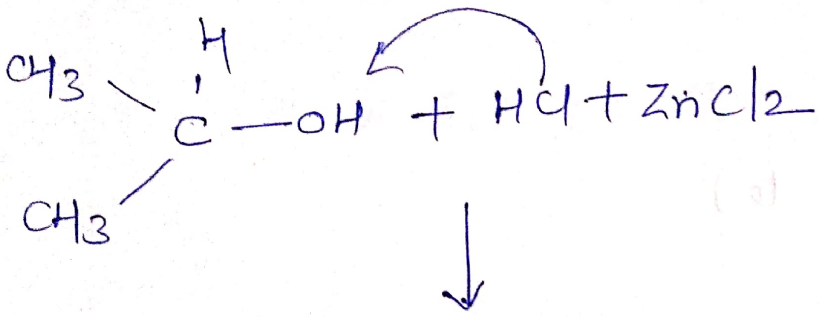
(2) Test for Secondary alcohol

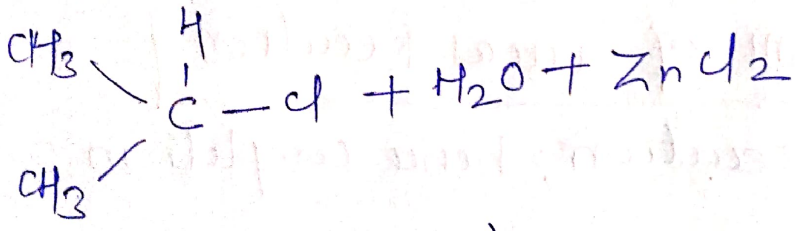
2° alcohol + Lucas reagent

↓

1) Oily layer is formed in 3-4 minutes.
2) Turbidity is observed.

$(CH_3)_2CHOH$ — 2° alc.



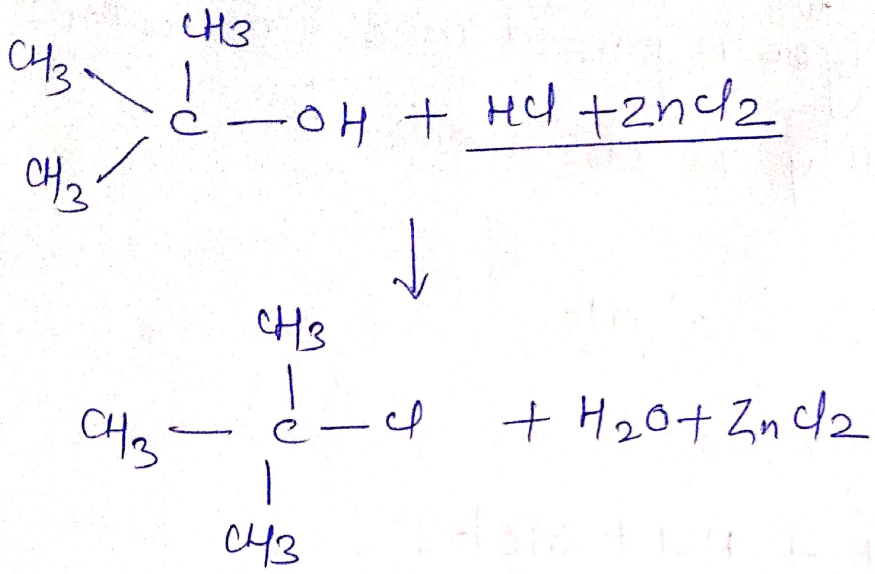


(Propyl chloride)

* Propyl chloride is responsible for turbidity in sol".

(3) Test for tertiary alcohols

→ 3° alcohol quickly form an oily layer & turbidity is also observed.

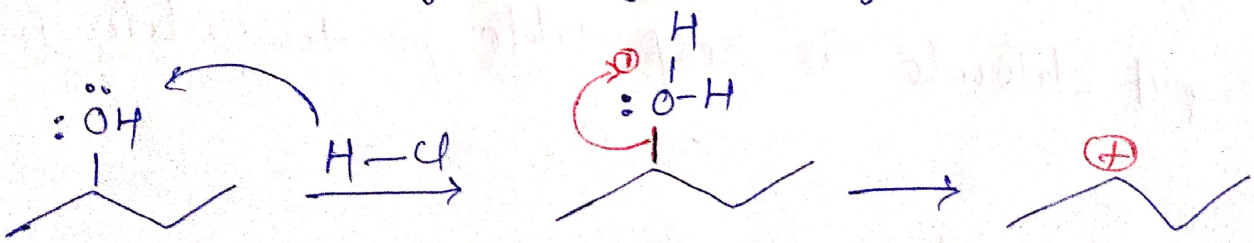


(butyl chloride)

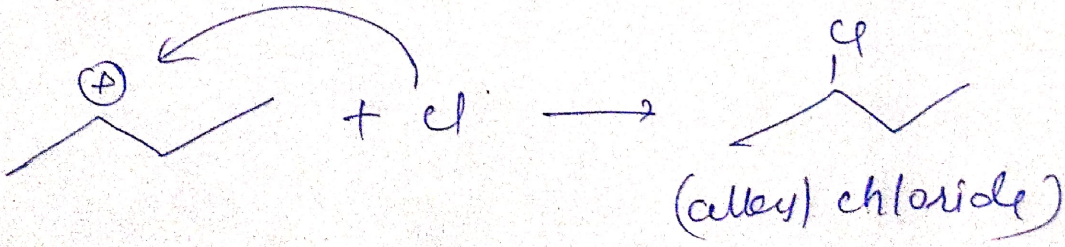
Mechanism of Lucas Reaction

* It follow SN1 reaction; hence complete in 2 steps.

(I) Protonation of hydroxyl group & ~~formation of~~



(II) Attack of Cl on carbocation.



(alkyl chloride)

Observation

Type of alcohol	observation
Primary	No change in sol". upon heating an oily layer is formed.
Secondary.	solution turn turbid, oily layer formed (3-5 min)
Tertiary	Turbid solution, oily layer is formed.

* Rate of reaction is according to carbocation stability

$3^{\circ} > 2^{\circ} > 1^{\circ}$ alcohol

Victor Meyer test

→ In this method 1°, 2°, 3° alcohol are subjected to series of chemical analysis. & colour of resulting solution is observed.

Steps

1) Alc. is treated ∵ I_2 in presence of red-phosphorus to obtain Indol alkane.

2) Indol alkane react ∵ alc. $AgNO_2$ to obtained nitro-alkane.

3) Nitro-alkane is treated ∵ Nitrous acid ($CH_3NO_2 + HCl$) & resulting sol" made alkaline.

4) Colour observed

a) Primary alcohol ⟶ Red blood colour

b) Secondary alcohol ⟶ blue colour

c) Tertiary alcohol ⟶ No. colour.

Reactions

1) Primary alcohol

$$R-CH_2-OH \xrightarrow{P+I_2} RCH_2I \xrightarrow{AgNO_2} R-CH_2NO_2$$

$R-CH_2NO_2$ $\xrightarrow{\text{Nitrous acid}}$ $R-\underset{\underset{N-OH}{\|}}{C}-NO_2$ (Nitrolic acid) ⟶ Blood red colour (when made alkaline)

Secondary

$$R-CHOH \xrightarrow{P+I_2} R_2CHI \xrightarrow{AgNO_2} R_2CHNO_2$$

R_2CHNO_2 $\xrightarrow{HNO_2}$ $R_2C(NO_2)(NO)$ (Pseudo nitrol)

$R_2C(NO_2)(NO)$ $\leftarrow$ Blue colour with alkali

Tertiary

$$R_3C-OH \xrightarrow{P+I_2} R_3CI \xrightarrow{AgNO_2} R_3CNO_2$$

R_3CNO_2 $\rightarrow$ (No reaction)

STRUCTURE AND USES OF C_2H_5OH

→ Alcohol is an organic compound in which hydroxyl group ($-OH$) is bound to a saturated carbon.

→ Ethyl alcohol is generally called as alcohol, ethanol and drinking alcohol.

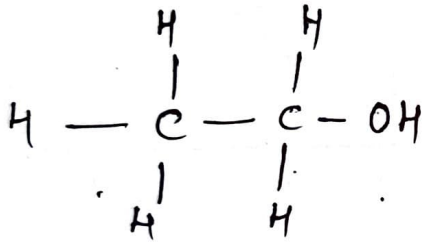
→ General formula ⟶ C_2H_5OH

→ Molar Mass ⟶ 46.07 g/mol

→ Boiling point ⟶ 78°C

→ Solubility ⟶ water soluble

* STRUCTURE OF Alcohol



→ Hybridization on 'C' is sp^3

→ O–H bond is polar bond

USES

① Antiseptic : used in medical wipes & act as antibacterial in hand sanitizers gels.

② Antidols : Antidots for CH_3OH & ethylene glycol poisoning.

③ Medicinal solvent

→ In high con' used to dissolve many H_2O insoluble medications and related compounds.

④ Pharmacology : It is extensively metabolized by liver, it also increase the acid secretion in stomach.

⑤ Engine fuel : The largest single use of ethanol is as an engine fuel & fuel additive.

⑥ Recreational : It is a CNS depressant, causes ephoria and increase sociability and talkativeness.

"Methyl Alcohol"

→ G.F. → CH_3OH

→ Methanol acquired name "wood alcohol" b/c it was once produced chiefly as byproduct of destructive distillation of wood.

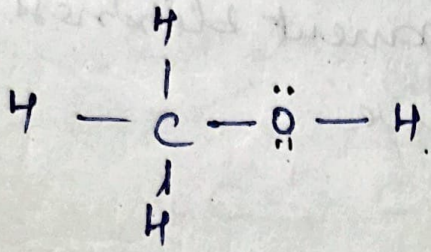
→ IUPAC : Methanol

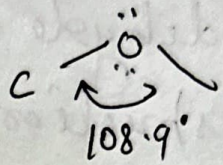
→ Other Name : Carbinol, columbian spirit, Hydroxy Methane, wood spirit etc.

- Molar Mass : 32.04 g/mol

- Appearance → Colourless Liquid.
→ Boiling point → 64.7 °C
→ solubility → H_2O Misible.

STRUCTURE





USES

(1) Chemical Industry
→ Majorly it is used to make other chemicals.
→ 40% CH_3OH is converted to formaldehyde.
→ other diverse products as plastic, plywood, paints explosive and permanent press textiles.

(2) fuel to vehicle :
→ CH_3OH is occassionally used to fuel internal combustion engines.

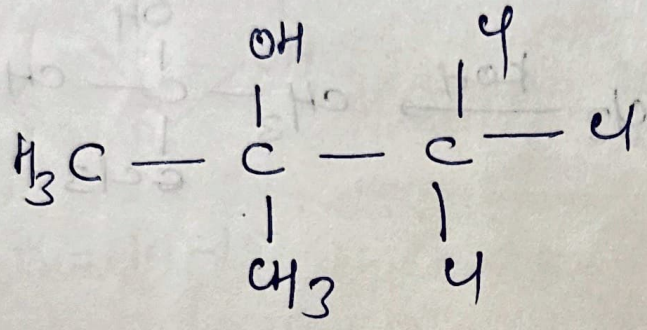
(3) Solvent : It is used as common laboratory solvent in UV, & HPLC.

CHLOROBUTANOL

→ chlorobutanol ⟶ (Trichloro-2-methyl 2-propanol)

→ General formula → $C_4H_7Cl_3O$

→ IUPAC & STRUCTURE



IUPAC : 1,1,1 trichloro-2-methyl propan 2-ol.

→ Molar Mass : 177.45g/mol

→ Appearance : white, volatil, solid

→ odor : menthol like

→ M.P. : 95-99° c

→ Solubility : slightly soluble, freely soluble in acetone.

Preparation of chlorobutanol

→ It is simply nucleophillic addition reaction.

→ $CHCl_3 + CH_3\overset{O}{\overset{\|}{C}}-CH_3$

→ This reaction is driven by KOH/NaOH.

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CHCl_3 \xrightarrow{KOH} CH_3-\overset{OH}{\overset{|}{C}}(CCl_3)-CH_3$$

USES

1) It has local anaesthetic property.
2) Topically used along ε clove oil.
3) Employed as sedative & hypnotics.
4) As antiseptic & local anaesthetics.
5)

Side effect

1) Skin irritant
2) Eye irritant
3) Neurotoxic effect

Cetostearyl alcohol

→ It is a mixture of fatty alcohols, consisting predominantly of CETYL and STEARYL ALCOHOLS

→ It is classified as fatty alcohol.

→

n = 14-16

(Cetostearyl alcohol)

Stearyl alcohol

Cetyl alcohol.

	Cetyl alcohol	Stearyl alcohol.
Chemical for.	$C_{16}H_{34}O$	$C_{18}H_{38}O$
IUPAC	Hexadecan-1-ol	octadecan-1-ol
other name	cetanol, Ethol Palmityl alcohol	octodecyl ale. Stearyl alcl
Molar Mass	242.45 g/mol	270.49 g/mol
Appearance	White crystal	whit solid
odour	Very faint	Very faint
Solubility	Soluble in H_2O, C_6H_6	ether, C_6H_6, $CHCl_3$

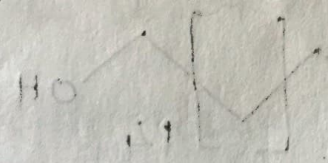
USES

1) Used in the cosmetic industry as an opacifier in shampoo, or as an emollient, emulsifier, or thickening agent.

2) Emollient: chemical that make epidermis external layer more soft.

2) Used as lubricants.

⇒ They are used to reduce friction between surfaces.



Benzyl alcohol

G.formula → C_7H_8O

IUPAC Name → phenyl methanol

other name → phenyl carbinol

molar mass → 108.14 g/mol

Appearance → colourless liquid

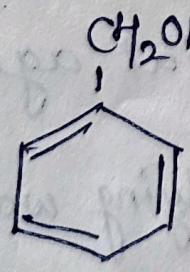
odor → Slightly aromatic

Density → 1.044 g/cm³

Boilling point → 205.3°C

Solubility in H_2O → soluble in C_6H_6, C_2H_5OH, CH_3OH, $CHCl_3$, ether & Acetone.

Structure



Preparation

- Benzyl alcohol is prepared by the hydrolysis of benzyl chloride using NaOH

$$C_6H_5CH_2Cl + NaOH \quad \text{(Benzyl chloride)}$$

$$\downarrow$$

$$C_6H_5CH_2OH + NaCl$$

(Benzyl alcohol)

USES

1) It is used generally for ink, waxes, paints and in epoxy resins.
2) It is also used in e-liquid for e-cigrate to enhance flavour.
3) It's 10% concentration is used as local anaesthetic, and antimicrobial agent.
4) Used as a dye solvent. In dying wool, nylon and leather.
5) Used as photographic developer & insect repellent.