DATE: Chemical reactions of alcohol :-

1. Alcohol react with sodium and Potassium to form alkoxides with the liberation of hydrogen gas.

$$2ROH + 2Na \longrightarrow 2R\bar{O}\overset{+}{Na} + H_2$$

$$2CH_3CH_2OH + 2Na \longrightarrow 2CH_3CH_2\bar{O}\overset{+}{Na} + H_2\uparrow$$

2. Reaction with Phosphorous Haliole → Alcohols reacts with phosphorous pentahaliole (PX_5)

$$R-OH + PX_5 \longrightarrow R-X + POX_3 + HX$$

$$CH_3CH_2-OH + PBr_5 \longrightarrow CH_3CH_2-Br + POBr_3 + HBr$$

3. Reaction with thionyl chloride – Alcohols reacts with thionyl chloride ($SOCl_2$) to form alkyl chlorid

$$R-OH + SOCl_2 \longrightarrow R-Cl + SO_2\uparrow + HCl\uparrow$$

$$CH_3CH_2-OH + SOCl_2 \longrightarrow CH_3CH_2-Cl + SO_2\uparrow + HCl\uparrow$$

4. Reaction with Hydrogen halide → Alcohols reacts hydrogen halide (HX) to form the corresponding alkyl halide.

$$R-OH + HX \longrightarrow R-X + H_2O$$

Mechanism

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Prolonation of ethyl alcohol

$$CH_3-CH_2-\ddot{O}-H + H^+ \longrightarrow CH_3-CH_2-\overset{\overset{H}{|}}{\overset{+}{O}}-H$$

Step II –

Nucleophile (Br^-) attacks the carbon holding the prolonated –OH group to form ethyl bromide.

$$Br^- + CH_3-CH_2-\overset{\overset{H}{|}}{\overset{+}{O}}-H \rightarrow CH_3-CH_2-Br + H_2O$$

5. Reaction with nitric acid – Form alkyl nitrate

$$CH_3CH_2-OH + HO-NO_2 \rightarrow CH_3CH_2-O-NO_2 + H_2O$$

6. Reaction with Sulphuric acid →

(i) When ethyl alcohol reacts with conc H_2SO_4 at room temp. ethyl hydrogen sulphate is formed

$$C_2H_5OH + HOSO_2-OH \xrightarrow[\text{Temp}]{\text{Room}} C_2H_5-O-SO_2OH + H_2O$$

(ii) Dehydration of alcohol to alkene → Treated with conc H_2SO_4 at 170°C Ethylene is formed.

$$CH_3CH_2-OH \xrightarrow[170^\circ C]{\text{conc } H_2SO_4} CH_2=CH_2 + H_2O$$

DATE: Dehydration of Secondary and Tertiary alcohol containg four or more carbon atoms gives a mixture of two alkene.

$$CH_3-CH_2-\underset{OH}{\underset{|}{CH}}-CH_3 \xrightarrow[H_2SO_4]{Conc} CH_3-CH_2CH=CH_2 + CH_3-CH=CH-CH_3$$

1-Butene (Minor) 2-Butene (Major)

Dehydration of alcohol to ether → When excess of ethyl alcohol is treated with conc Sulphuric acid at 140°C diethyl ether is found.

$$CH_3-CH_2-OH + HO-CH_2CH_3 \xrightarrow[140^\circ C]{Conc\ H_2SO_4} CH_3CH_2-O-CH_2CH_3 + H_2O$$

Diethyl ether

Secondary alcohol lose hydrogen and yield ketone.

$$CH_3-\underset{OH}{\underset{|}{CH}}-CH_3 \xrightarrow[300^\circ C]{Cu} CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + H_2$$

Tertiary alcohol are not dehydrogenated but lose a molecule of water to give alkenes:-

$$CH_3-\underset{CH_3}{\underset{|}{C}}-OH \xrightarrow[300^\circ C]{Cu} CH_3-\underset{CH_3}{\overset{CH_2}{\overset{\|}{\underset{|}{C}}}} + H_2O$$

2-Methyl propene.