

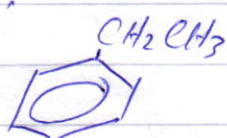
## **CHAPTER FIVE ...**

# **ARENES & THEIR DERIVATIVES**

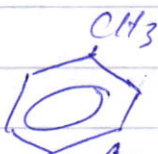
# Chapter -      Arenes and their derivatives

## A / structure and nomenclature :

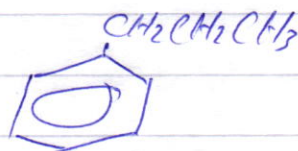
Many important hydrocarbons are not just aliphatic or just aromatic, however, but contain both aliphatic and aromatic units; hydrocarbons of this kind are known collectively as arenes. For example; Ethylbenzene, contains a benzene ring and an aliphatic side chain.



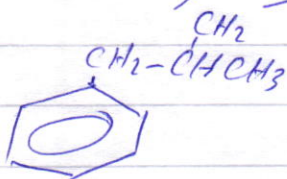
Ethylbenzene



Methylbenzene  
or (Toluene)

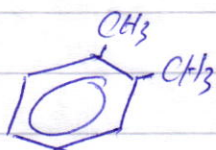


n-propylbenzene

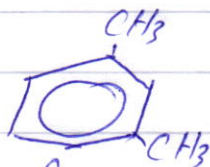


Isobutylbenzene

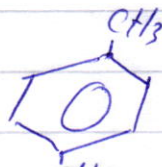
The simplest of the dialkylbenzenes, the dimethylbenzenes, are given the special name of Xylenes:



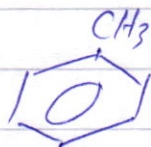
O-Xylene



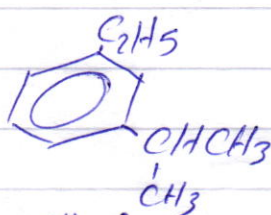
m-Xylene



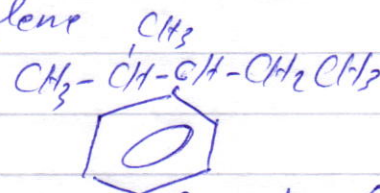
P-Xylene



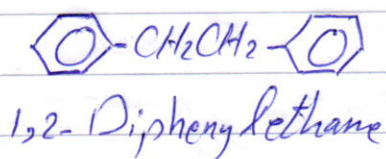
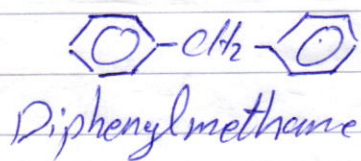
p-Ethyltoluene



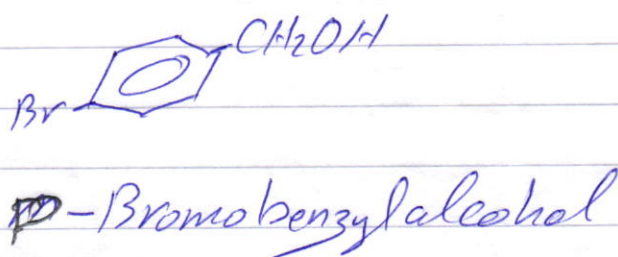
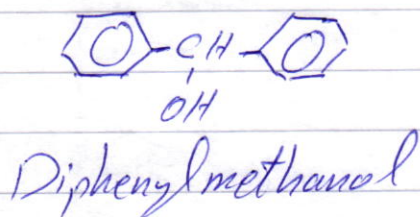
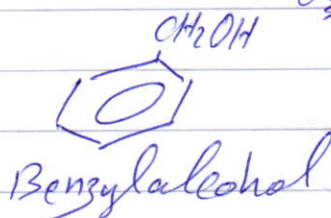
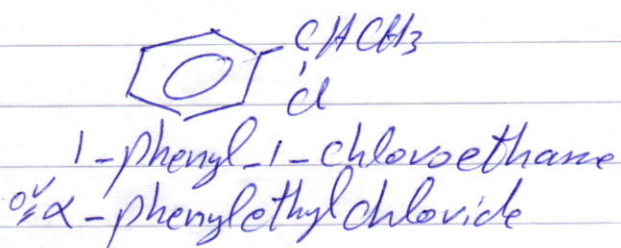
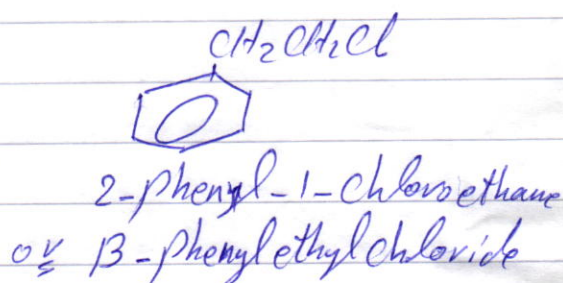
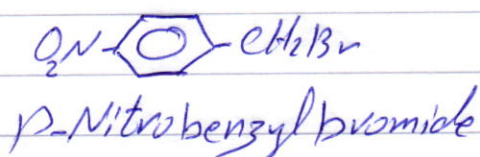
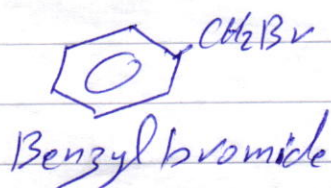
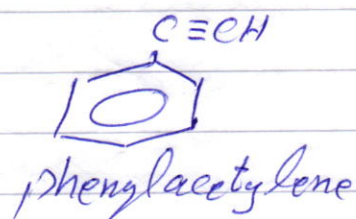
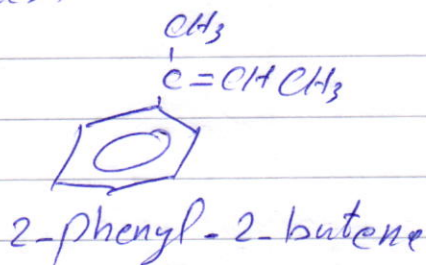
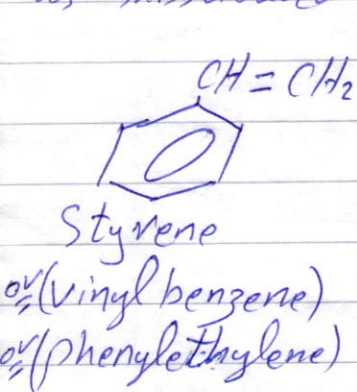
m-Ethylisopropylbenzene



2-Methyl-3-phenylpentane



The simplest alkylbenzene has the special name styrene. Others are generally named as substituted alkenes, occasionally as substituted benzenes.





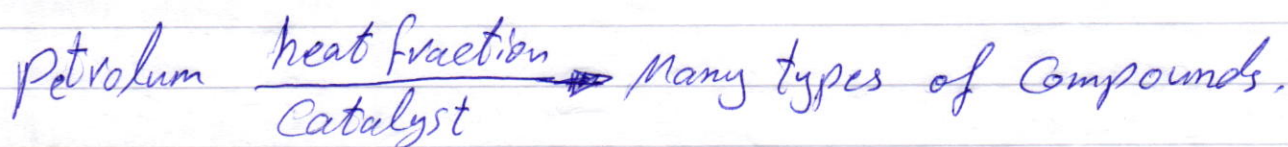
## 13 / Physical properties

As compounds of low polarity, the alkylbenzenes possess physical properties that are essentially the same as those of the hydrocarbons. They are insoluble in water, but quite soluble in non-polar solvents. The boiling points rise with increasing molecular weight.

## C / Preparation of alkyl benzene

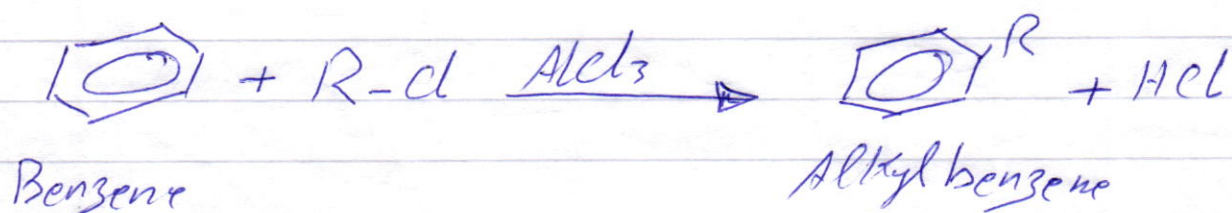
### ① Industrial source :

Petroleum is the chief source of the preparation of benzene and alkylbenzene like; toluene and the xylenes... etc.



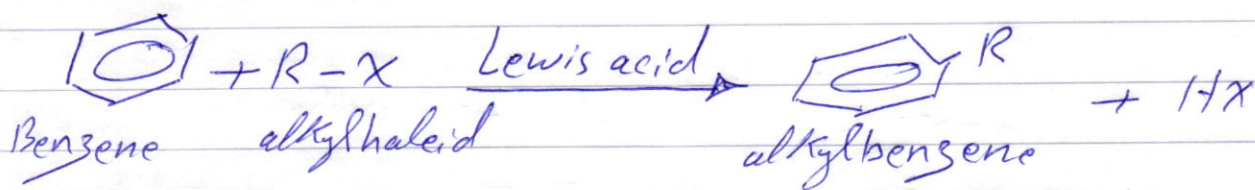
### ② Laboratory Source :

Benzene is the chief compound of the preparation of arenes and their derivatives; so that, in this section, we are study alkyl benzene (preparation & reactions) as a sample of this kind of compound.



A number of the simpler alkylbenzene are available from industrial and laboratory sources, the ~~more~~ complicated compounds must be synthesized in one of the ways outlined below:

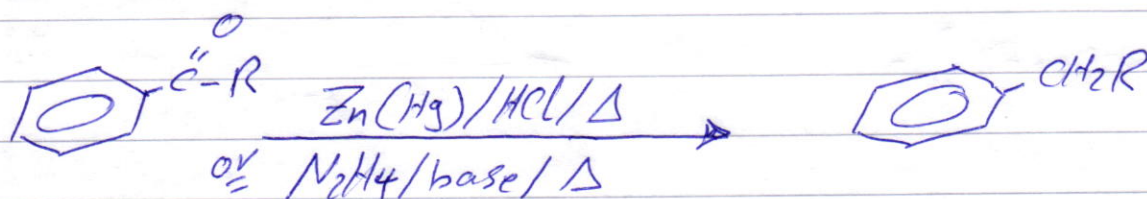
a. Attachment of alkyl groups (Friedel-Crafts alkylation):



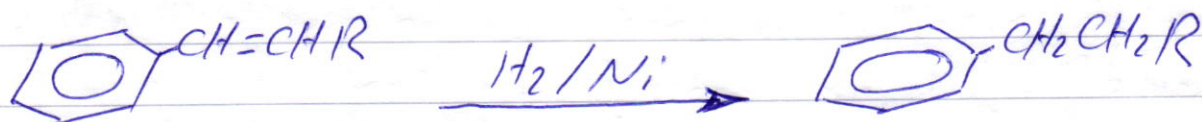
Where:  $R$  = aliphatic compounds.

Lewis acid =  $AlCl_3$ ,  $BF_3$ ,  $HF$ , ... etc.

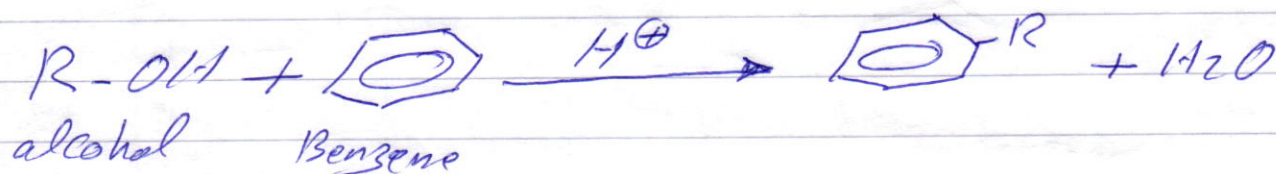
b. Conversion of side chain (Reduction of Carbonyl group):



c. Hydrogenation of double bonds:

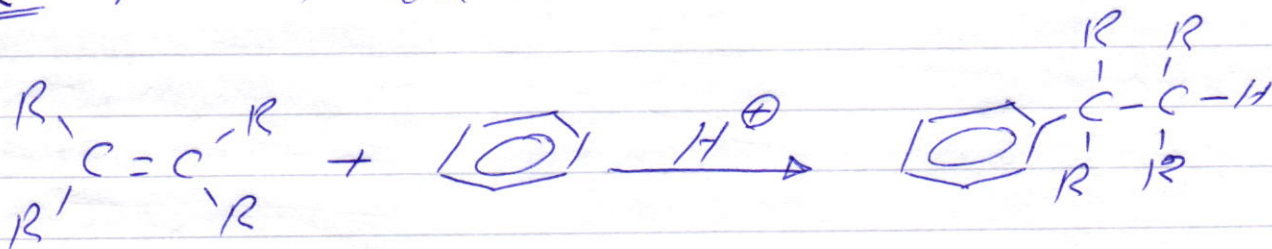


d. From Alcohols:



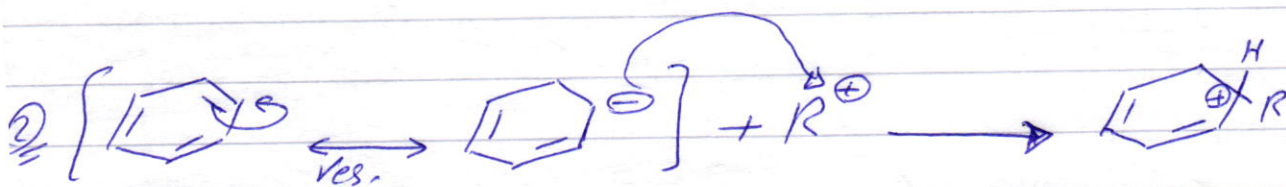
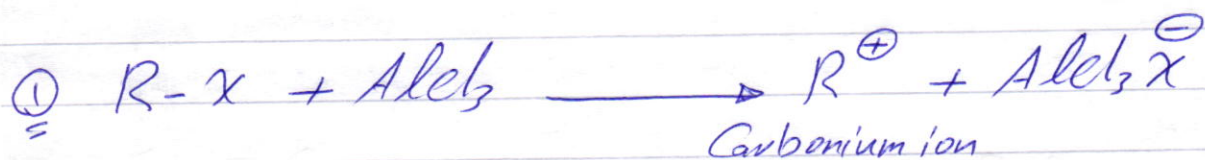
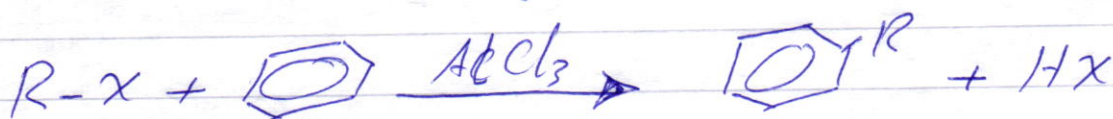


R. From Alkene

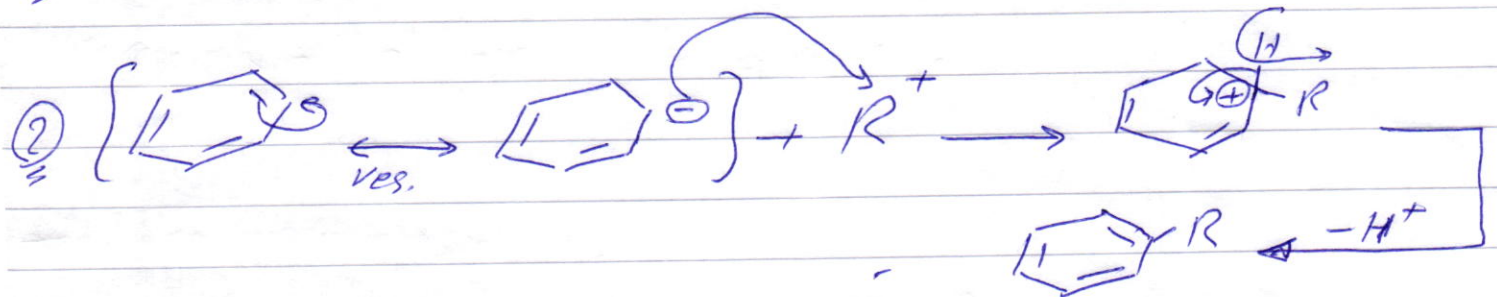
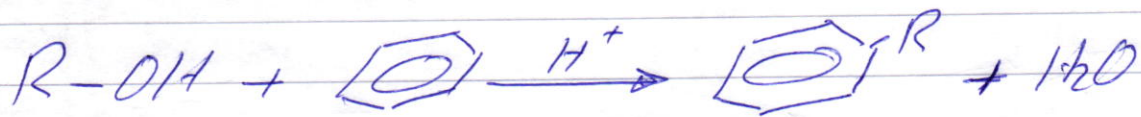


Where:  $R = H$  or alkyl group.

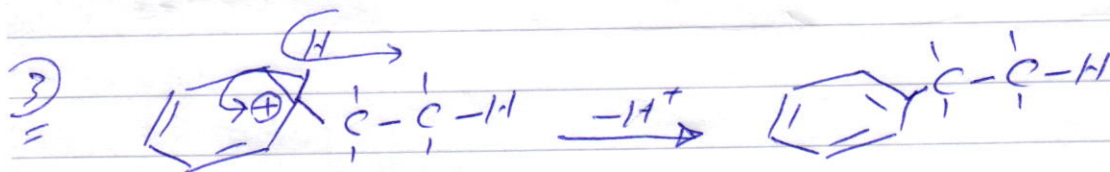
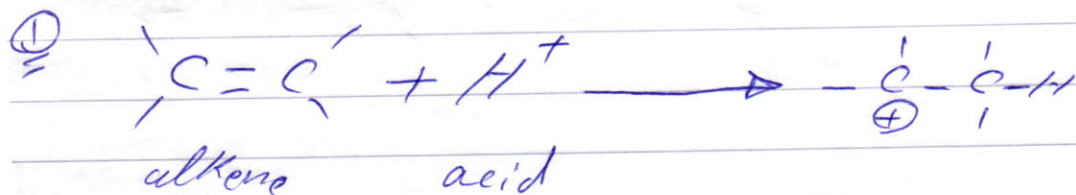
\* The mechanism of (a):



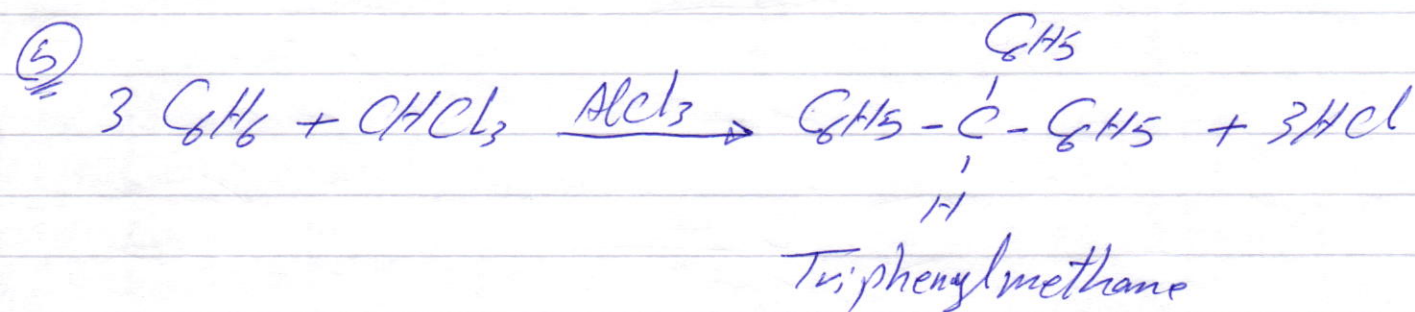
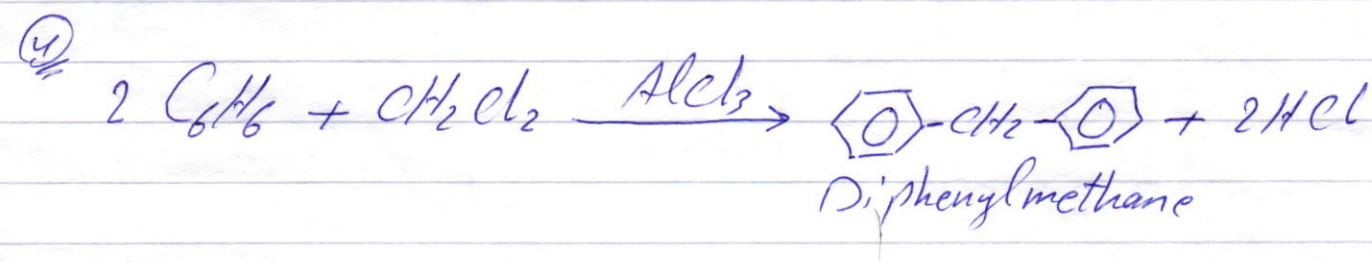
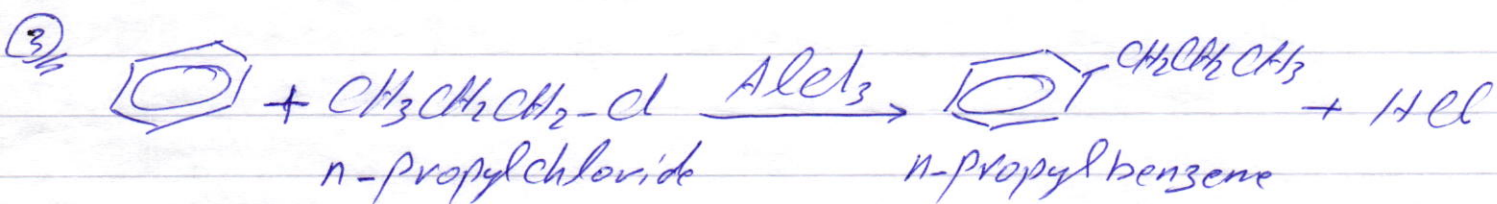
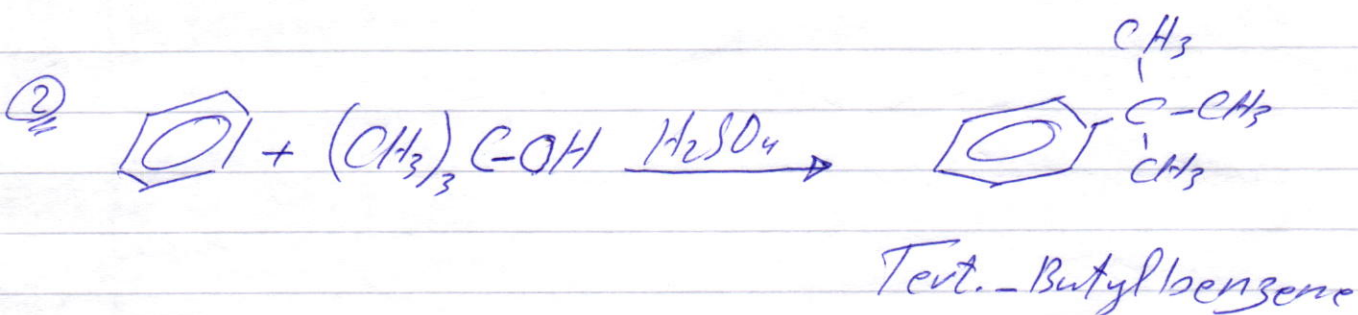
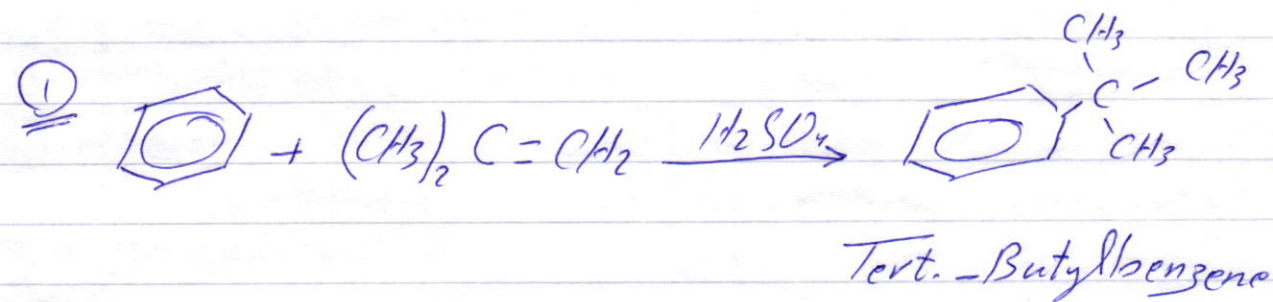
\* The mechanism of (d) :



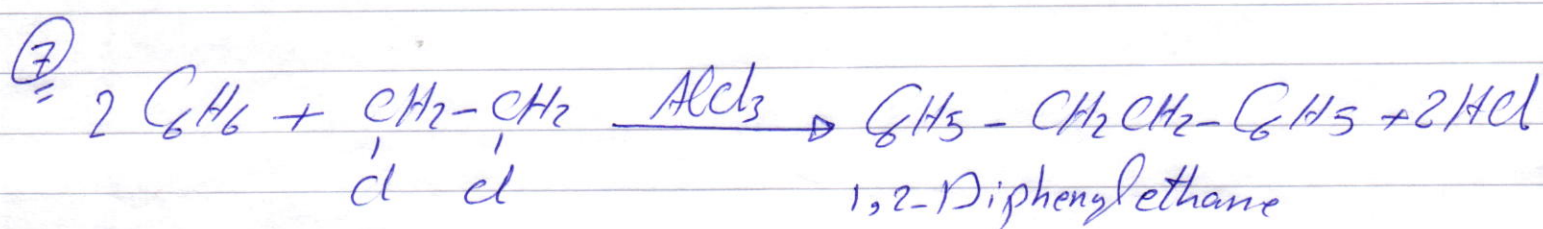
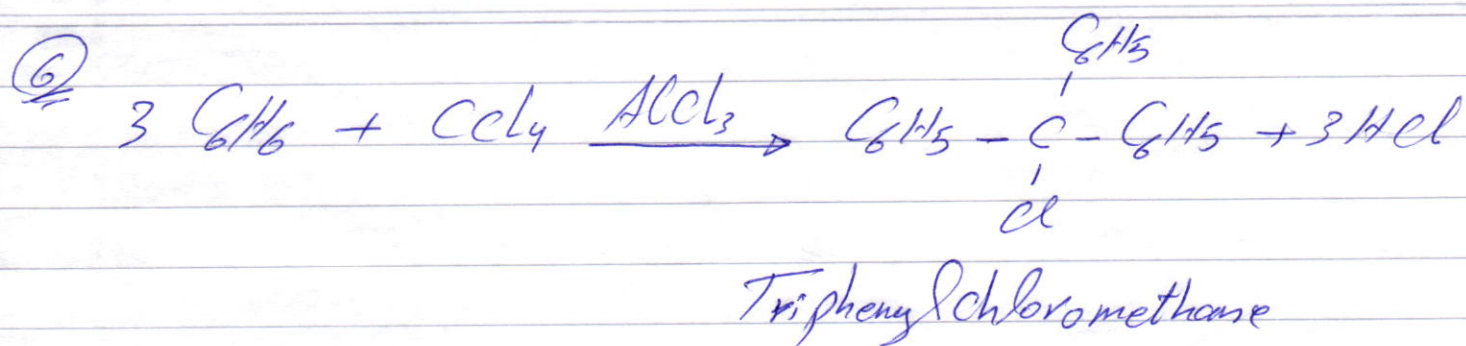
\* The mechanism of (e) :



examples:

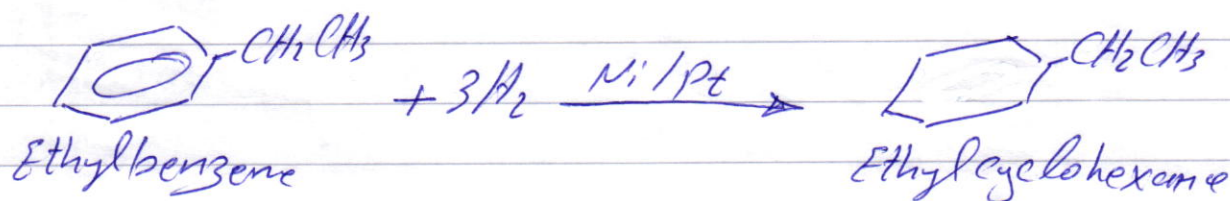




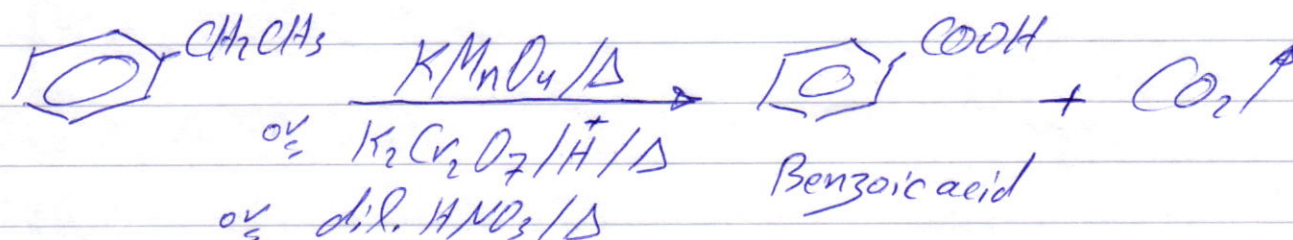


## D/ Reaction of Alkylbenzene :

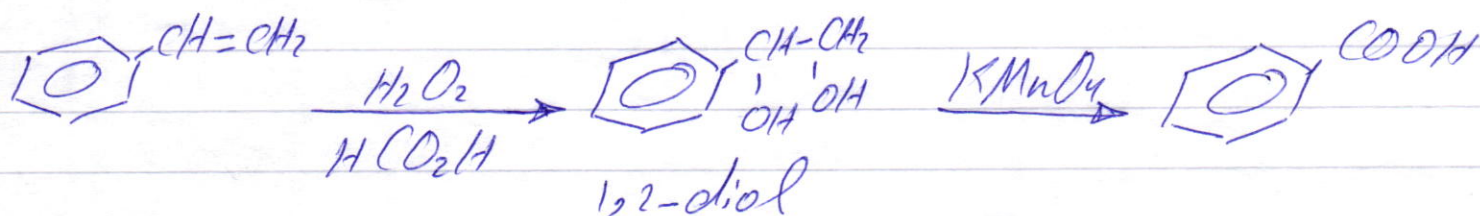
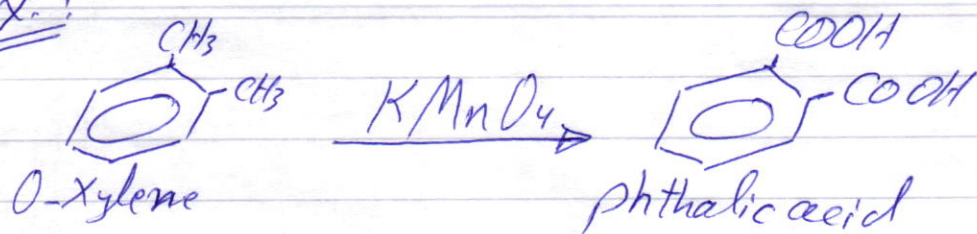
### ① Hydrogenation :



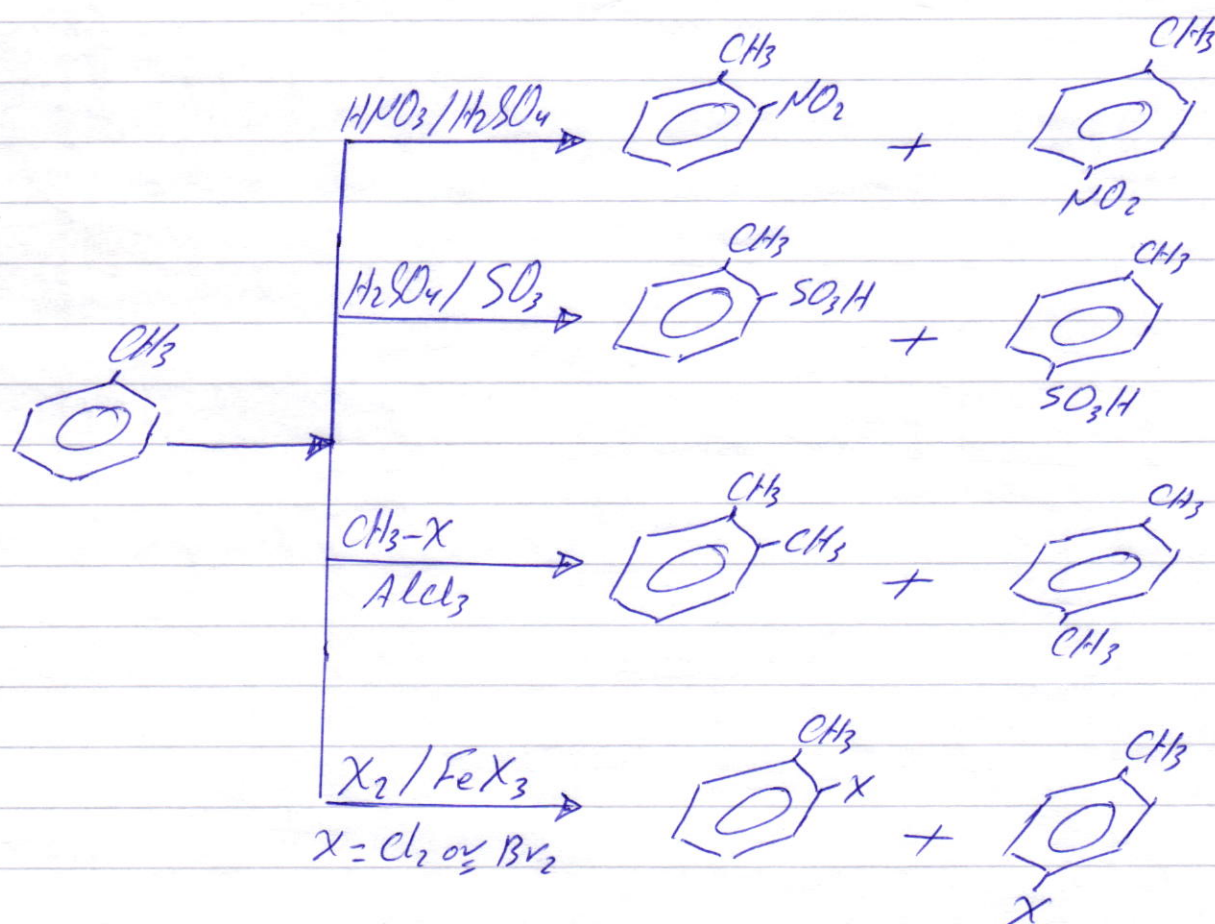
### ② Oxidation :



ex:

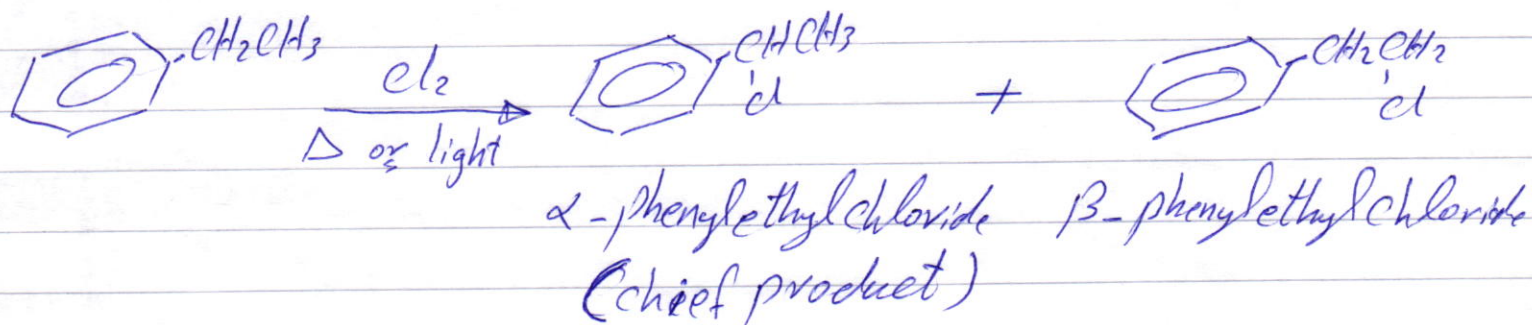
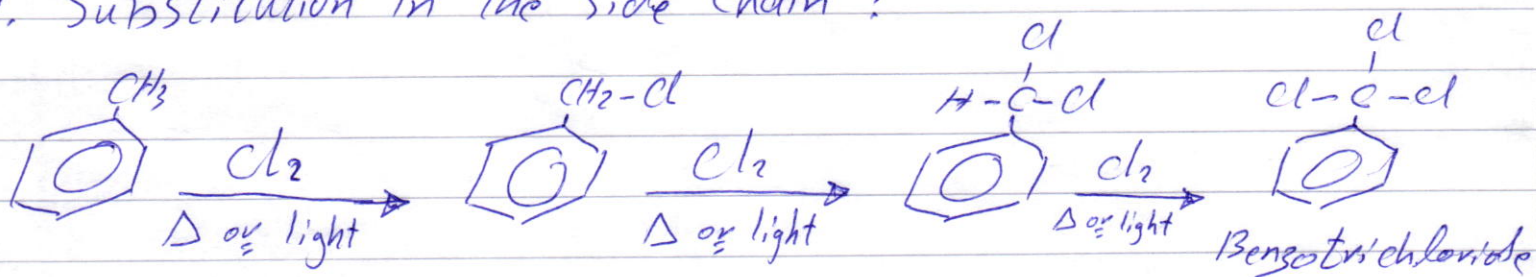


3 Substitution in the ring:





#### 4. Substitution in the side chain :



## Problems :

- ① How might you prepare, ethyl benzene from:  
a) benzene and ethyl alcohol b) acetophenone ( $C_6H_5COCH_3$ )  
c) styrene ( $C_6H_5CH=CH_2$ ) d)  $\alpha$ -phenylethyl alcohol
- ② Give structures and names of the principle organic product expected from each of the following reactions:
- a) benzene + cyclohexane + HF
- b) m-nitrobenzyl chloride +  $K_2Cr_2O_7$  +  $H_2SO_4$  +  $\Delta$
- c) p-Xylene +  $Br_2$  +  $Fe^{+2}$
- d) 1,3-Diphenylpropane +  $H_2$ , pd