



Pharmaceutical Organic Chemistry-2 (PC202) Final Examination

Time Allowed: 120 minutes

Total: 50 marks

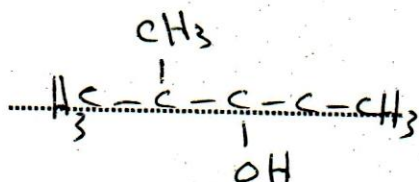
Read the following exam instructions carefully:

- You are provided with an exam booklet of. **(10) different pages.**
- The exam consists of three questions; proceed as instructed for each question.
- Answer each question only in the provided space. Do not use a pencil.

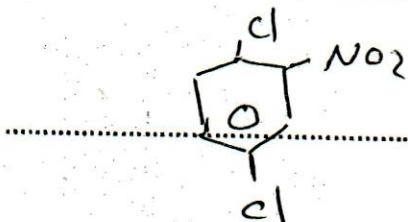
Question#I: (17 marks, 40 minutes)

A) Draw chemical structures for each of the following compounds? (2 marks)

i) 2-methyl-3-pentanol

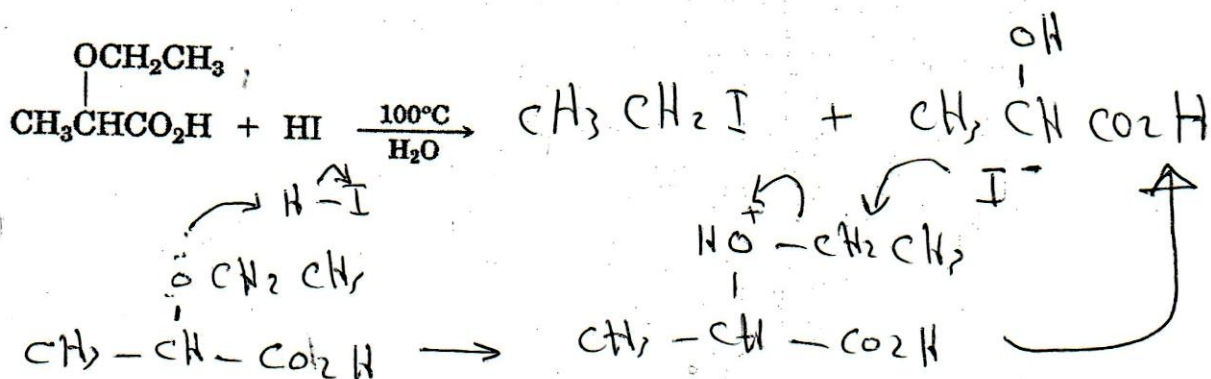


ii) 1,4-Dichloro-2-nitrobenzene

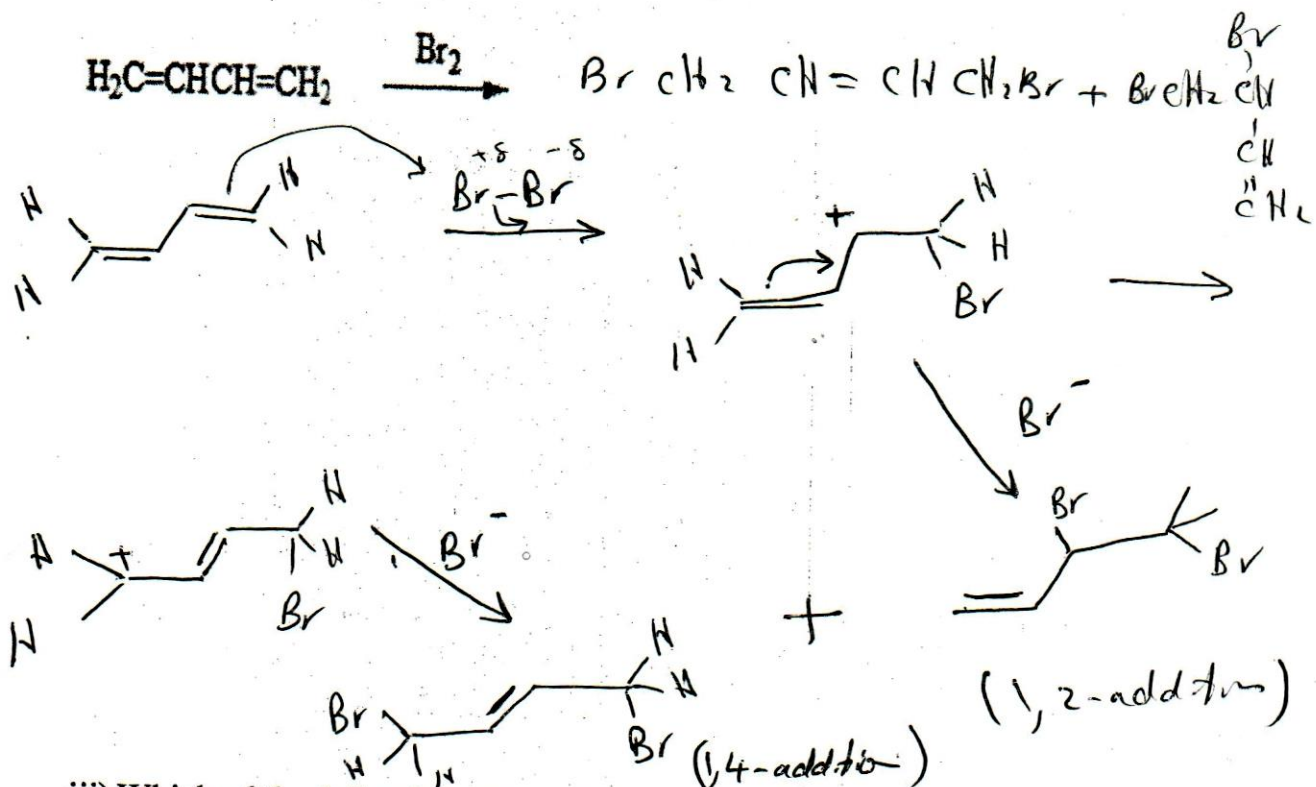


B) Complete and Write the mechanism of the following reactions? (6 marks)

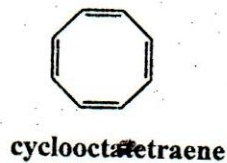
i)



ii)



iii) Which of the following compounds is aromatic if any? Explain your answers for each compound?



cyclooctatetraene

$4n + 2 = 8$

$= 6$

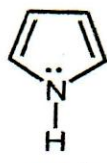
$= 1.5$

not aromatic

non-aromatic, monocyclic, conjugated

doesn't obey Huckel rule

$n = 1.5$



pyrrole

① planar

② monocyclic

③ conjugated

④ Huckel rule

$4n + 2 = 6$

$4n = 4$

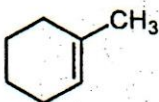
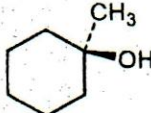
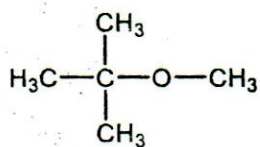
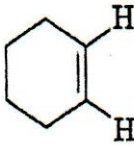
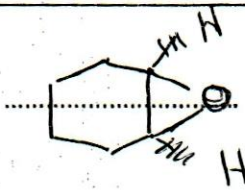
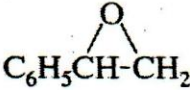
$n = 1$

aromatic

obeys Huckel rule

$n = 1$

C) For each of the following reactions give the structures of the missing reactants, reagents or products only in the provided space? (9 marks, 12 min)

Reactants	Reagents	Products
	1. $\text{Hg}(\text{OAc})_2/\text{H}_2\text{O}$ 2. NaBH_4	
$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{PCC} + \text{CH}_2\text{Cl}_2$	$\text{CH}_3\text{CH}_2\text{CHO}$
$\begin{array}{c} \text{OH} \\ \\ \text{CH}_3\text{CCH}_2\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array}$	$\text{Conc. H}_2\text{SO}_4$	$\begin{array}{c} \text{CH}_3-\text{C}=\text{CH}-\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \\ + \\ \text{CH}_2=\text{C}-\text{CH}_2\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array}$
$\begin{array}{c} \\ -\text{C}-\text{OH} \\ \\ + \\ \text{CH}_3\text{I} \end{array}$	NaH	
	1. $\text{Cl}_2 + \text{H}_2\text{O}$ 2. $\text{NaOH} + \text{H}_2\text{O}$	
	HI	$\begin{array}{c} \text{I} \\ \\ \text{C}_6\text{H}_5-\text{CH}-\text{CH}_2\text{OH} \\ + \\ \text{C}_6\text{H}_5-\text{CH}(\text{OH})-\text{CH}_2\text{I} \end{array}$

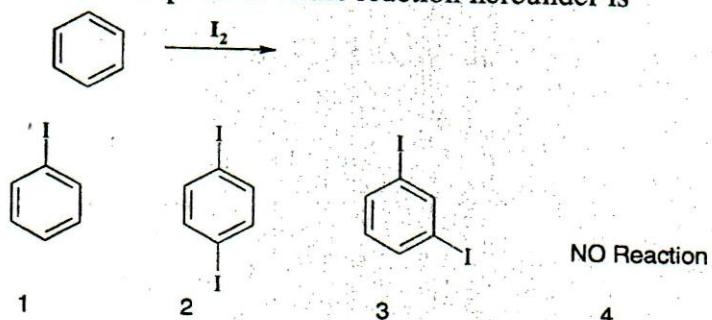
major
minor

Question #II: (16 marks, 40 minutes)

A. Choose the correct answer and fill in sheet I

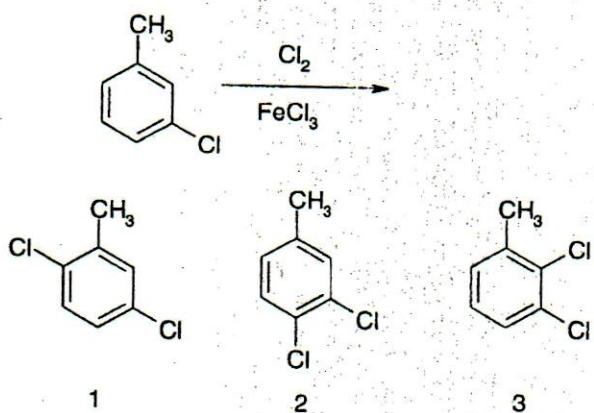
(7 marks)

- The most common reaction of aromatic compounds is
 - Electrophilic aromatic substitution reactions.
 - Nucleophilic aromatic substitution reactions
- All are true about bromination of benzene except
 - Benzene reacts as an electron donor (Lewis base or Nu)
 - The product is formed by loss of a proton, which is replaced by bromine.
 - FeBr₃ is added as a catalyst to polarize bromine reagent
 - None
- Hydroxy, alkoxy, and amino groups are ortho-para activators because
 - They have strong, electron-donating resonance effect
 - They have electron-donating inductive effect.
 - a and b
- The main product of the reaction hereunder is



- a) 1 b) 2 c) 3 d) 4

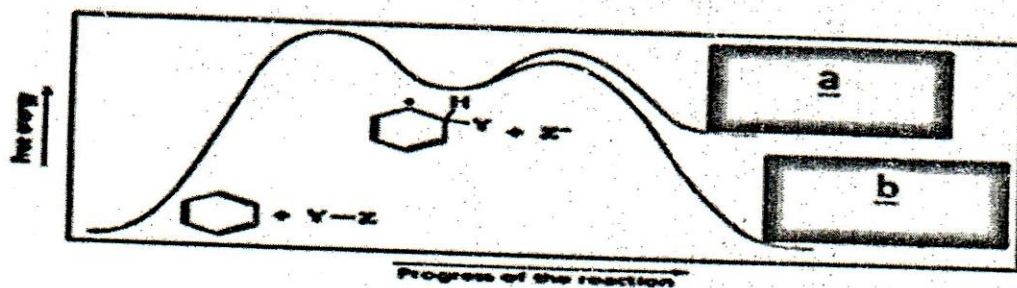
5. The products of the reaction hereunder are



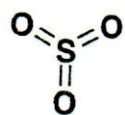
- a) All b) 1, 2 c) 1, 3 d) 2, 3

4

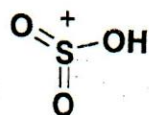
6. In the energy profile of the reaction of Br₂ with benzene hereunder,
 a) a is substitution product b) b is the substitution product



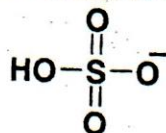
7. In the sulfonation reaction, the reactive electrophile is



(1)



(2)



(3)

a) 1

b) 2

c) 3

d) 1 and 2

8. The substituent in the compound hereunder is

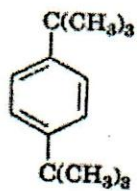
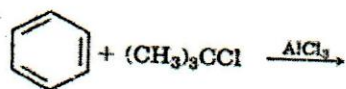


a) Ortho- and para-directing activators,

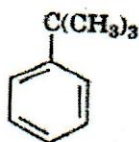
b) Ortho- and para-directing deactivators

c) Meta-directing deactivators.

9. The main product of the reaction hereunder is



(1)



(2)

NO Reaction
(3)

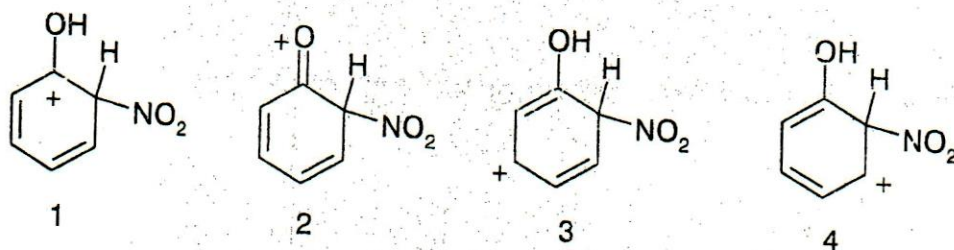
a) 1

b) 2

c) 3

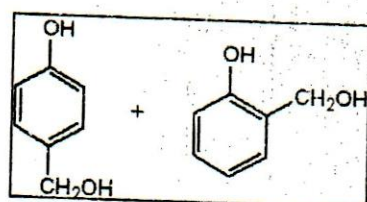
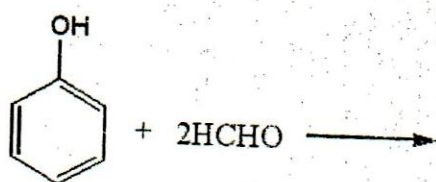
d) None

10. The most stable resonance in the nitration of phenol is

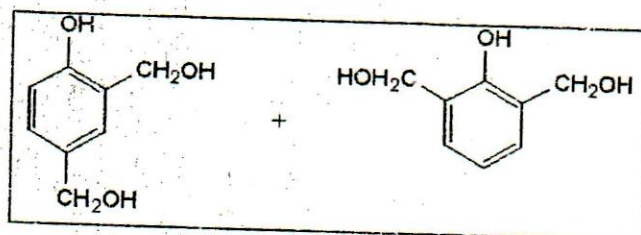


- a) 1 b) 2 c) 3 d) None

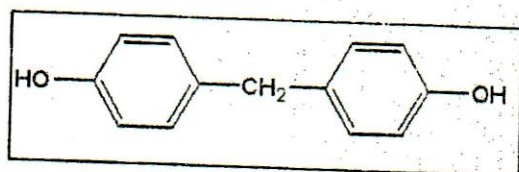
11. The product of the reaction hereunder is



(1)



(2)



(3)

- a) 1 b) 2 c) 3 d) None

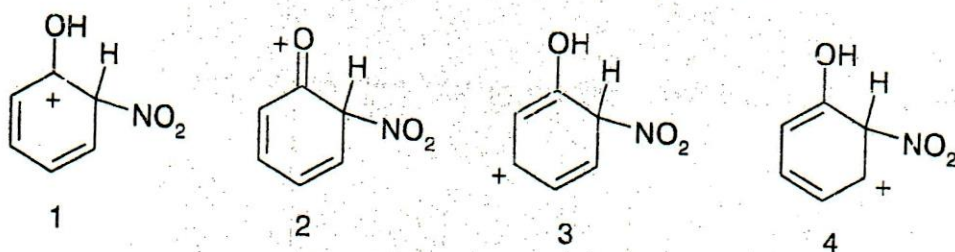
12. *O*-dichlorobenzene is used in the preparation of

- a) Salicylaldehyde b) Chatechol c) Resolcinol
 d) Hydrochinone e) None

13. Which is easier in nucleophilic aromatic substitution of chloride by OH group

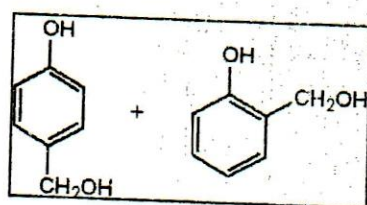
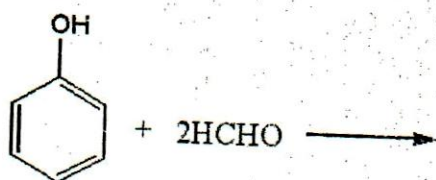
- a) 2,4,6-Trinitrochlorobenzene
 b) 2,4-Dinitrochlorobenzene
 c) 2,4,6-Trimethoxychlorobenze

10. The most stable resonance in the nitration of phenol is

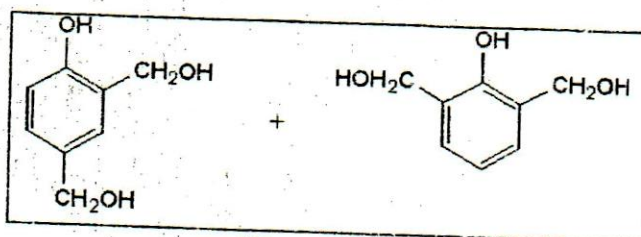


- a) 1 b) 2 c) 3 d) None

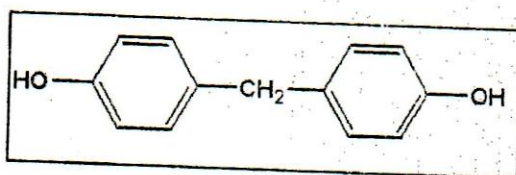
11. The product of the reaction hereunder is



(1)



(2)



(3)

- a) 1 b) 2 c) 3 d) None

12. *O*-dichlorobenzene is used in the preparation of

- a) Salicylaldehyde b) Chatechol c) Resolcinol
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13. Which is easier in nucleophilic aromatic substitution of chloride by OH group

- a) 2,4,6-Trinitrochlorobenzene
 b) 2,4-Dinitrochlorobenzene
 c) 2,4,6-Trimethoxychlorobenzene

14. Nucleophilic substitution on aromatic ring proceeds by addition/elimination mechanism. The attacking Nu first adds to electron-rich aryl halide, forming a resonance stabilized -ve charged addition intermediate (carbanion). Halide ion is then eliminated in the second step.

a) True

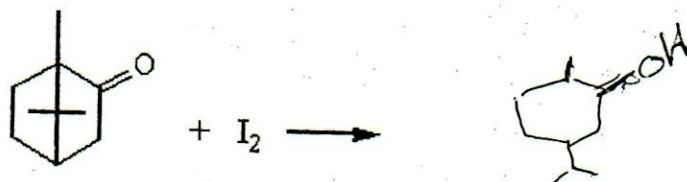
b) False

Sheet (I)

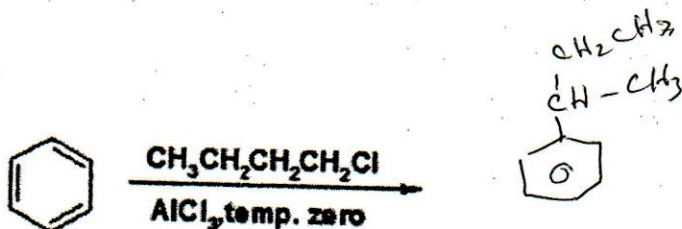
No	a	b	c	d	No	a	b	c	d
1	///				8			=	
2				///	9	///			
3	///				10		///		
4				///	11		///		
5		///			12		///		
6		///			13	///			
7				///	14		///		

B) Complete the following equations (if there is more than one product mention the main product) (6 marks)

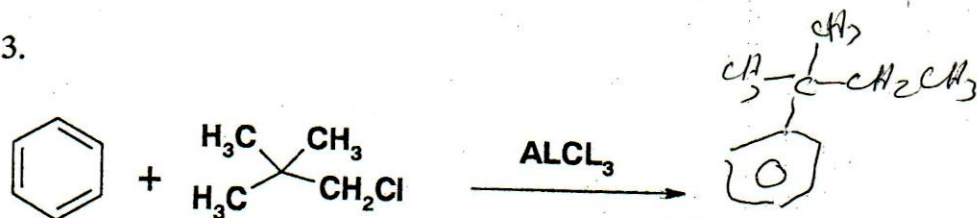
1.



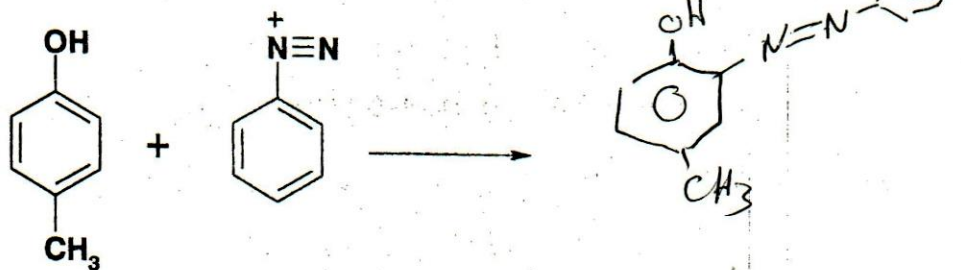
2.



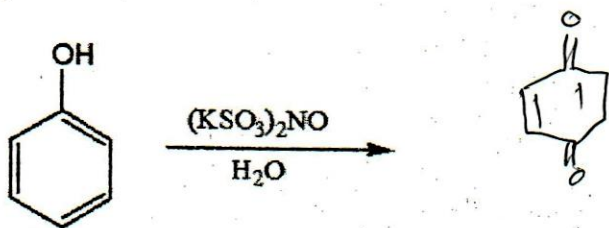
3.



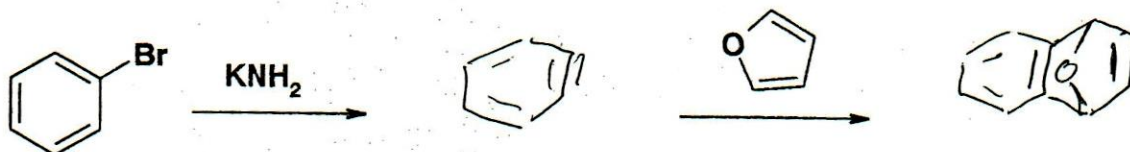
4.



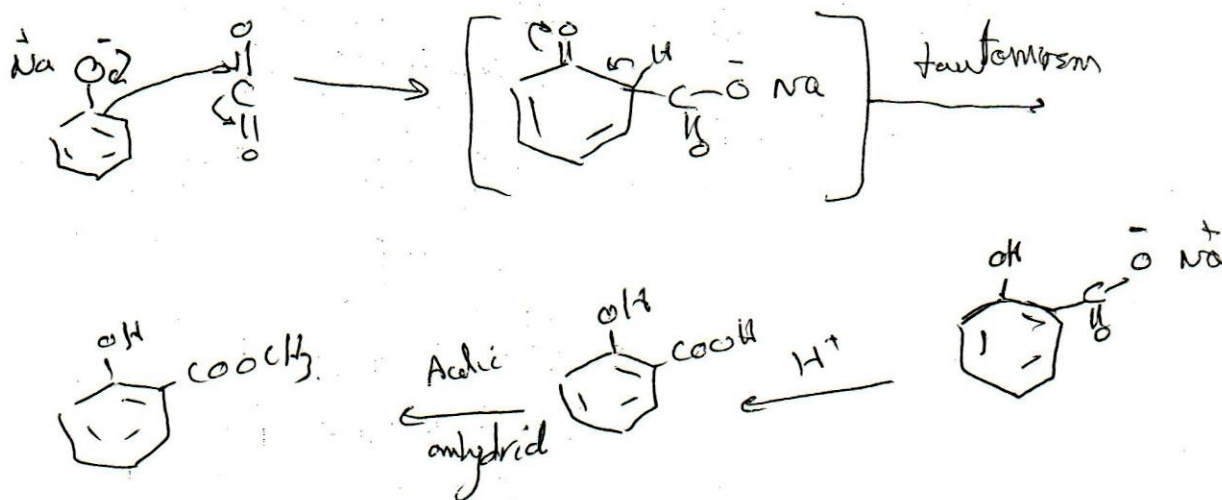
5.



6.

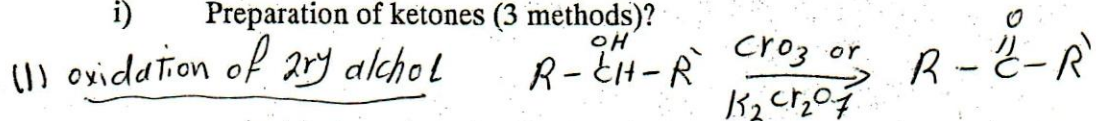


C) Discuss Kolbe reaction and preparation of aspirin? (3 marks)

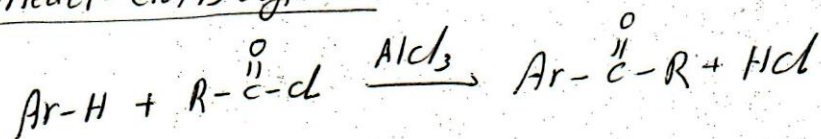


D) Discuss the followings: (17 marks)

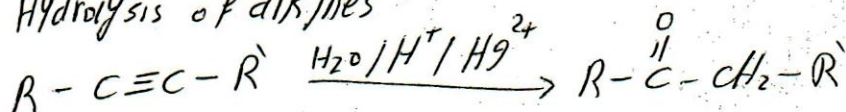
i) Preparation of ketones (3 methods)?



2) Friedel-Crafts acylation

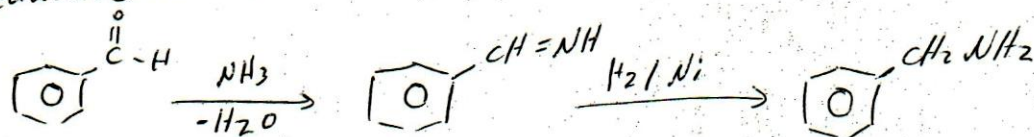


3) Hydrolysis of alkynes

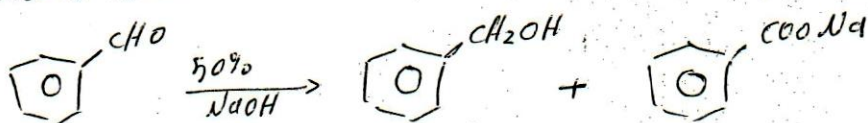


ii) Reactions of aldehydes (3 reactions)?

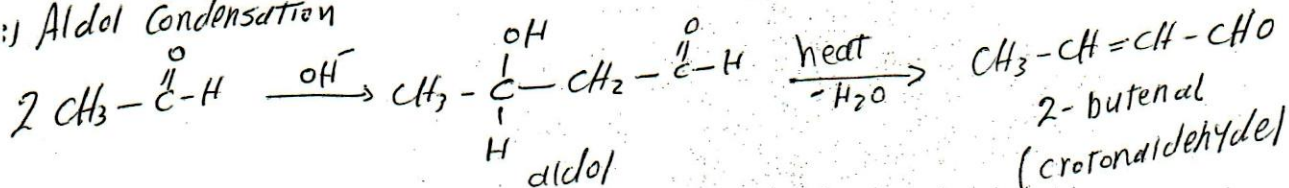
1) reductive amination



2) Cannizzaro reaction

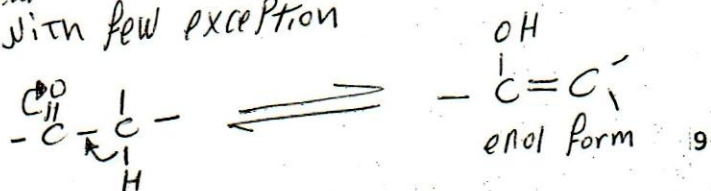


3) Aldol Condensation



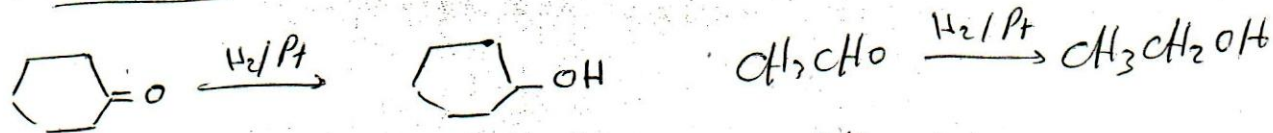
iii) Tautomerism?

A special type of interconvertible structural isomers that differ from each other only in the location of a double bond and a hydrogen relative to the oxygen. The keto form is usually predominant with few exceptions.

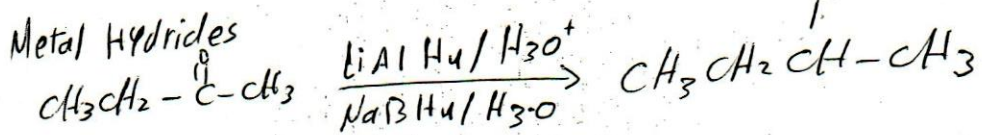


4) Reduction of aldehydes and ketones (3 methods)?

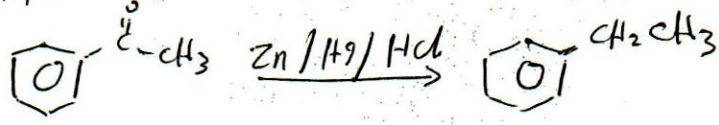
1) Hydrogenation



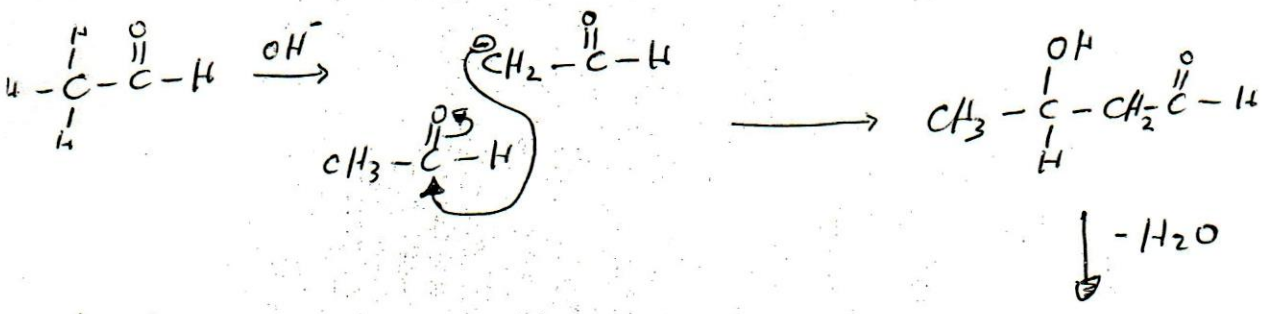
Metal Hydrides



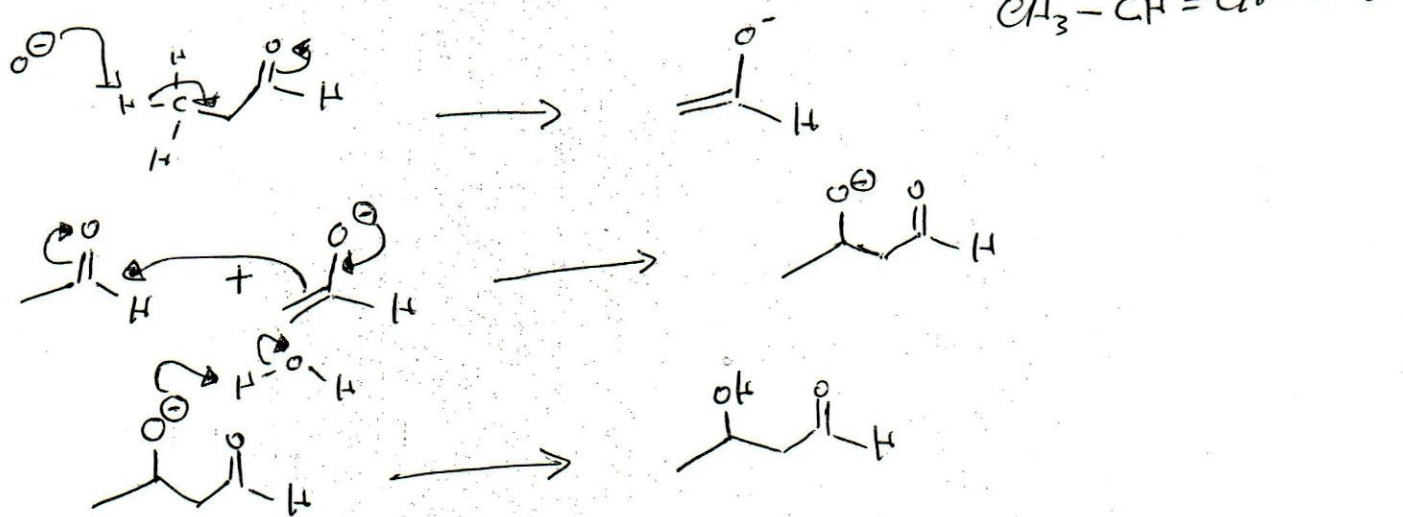
Clemmensen Reduction



5) Mechanism of Aldol condensation?



mechanism



Best Wishes