Total number of printed pages–6

14 (CHM–3) 303

2021

(Held in 2022)

CHEMISTRY

Paper : CH–303

(Foundations of Organic Synthesis)

Full Marks : 60

Time : 2½ hours

The figures in the margin indicate full marks for the questions.

1. Answer ***any two*** from the following questions : 5×2=10

(a) What do you mean by stereoselective and stereospecific reactions? Explain with examples. 5

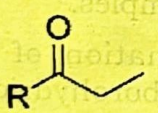
(b) Hydrogenation of acetophenone by sodium borohydride ($NaBH_4$) yields racemic mixture whereas hydrogenation in presence of chiral ruthenium complex results formation of (*S*)-1-phenylethanol preferentially over (*R*)-1-phenylethanol. Give reasons for the selectivity in product formation. 5

(c) Epoxidation of *cis*-2-butene using *m*-chloroperbenzoic acid (*m*-CPBA) results (2*R*, 3*S*)-2,3-dimethyloxirane ; whereas *trans*-2-butene yields (2*R*,3*R*)-2,3-dimethyloxirane. Give a justification for the selectivity. 5

2. Maleic acid on heating results formation of maleic anhydride whereas fumaric acid does not. Explain the reason with suitable chemical reaction. 3

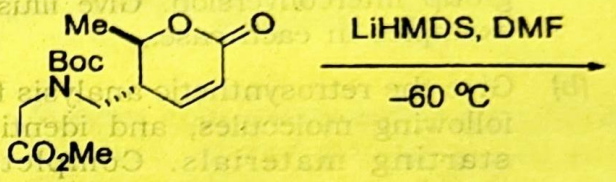
3. Answer ***any two*** from the following questions : 5×2=10

(a) Describe the methods (*one* each) for selective generation of *Z* and *E* boron enolates of the following compound.

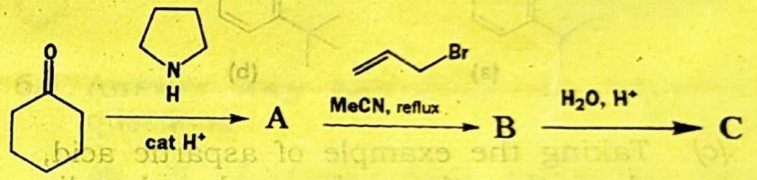


Explain the stereochemical outcome of aldol reaction of benzaldehyde with these enolates with suitable mechanism. 5

(b) Predict the product, indicating the stereochemical outcome, of the following reaction and give a suitable mechanism describing each steps. 5

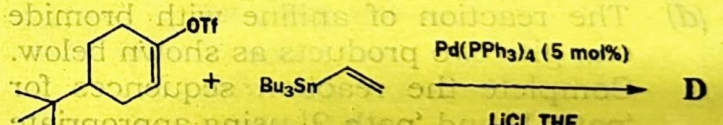


(c) Predict the product of each step of the following reaction and write a suitable mechanism for each step. 5



4. Predict the products of the following reactions : 1×2=2

(a)



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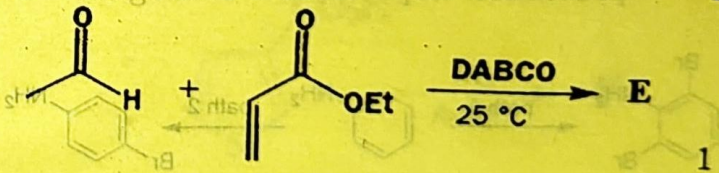
(b)



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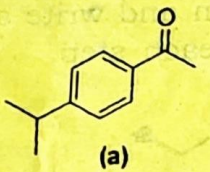
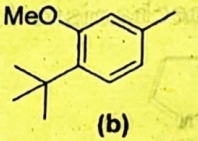
5. Answer ***any five*** from the following questions : 5×5=25

(a) Define the terms — (a) Retrosynthetic analysis (b) Disconnection (c) Functional group interconversion. Give illustrative examples in each case. 3+2=5

(b) Give the retrosynthetic analysis for the following molecules, and identify the starting materials. Complete the corresponding forward synthetic steps. 3+2=5



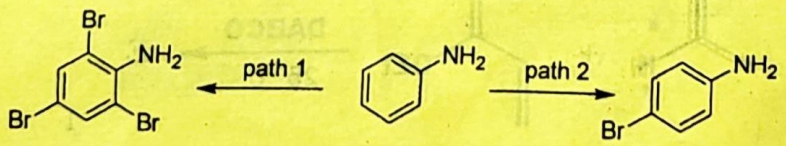
(a)



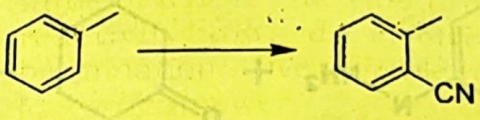
(b)

(c) Taking the example of aspartic acid, show that the amino and carboxylic acid groups can selectively be protected and deprotected. 5

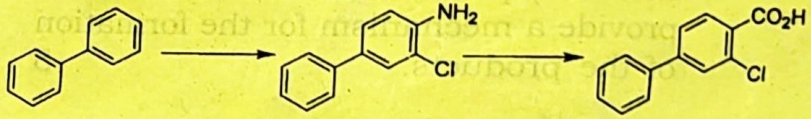
(d) The reaction of aniline with bromide can give two products as shown below. Complete the reaction sequences for 'path 1' and 'path 2' using appropriate protection-deprotection strategies. 5



(e) How can you synthesize the following compound by using aromatic nucleophilic substitution strategy? Explain briefly. 5



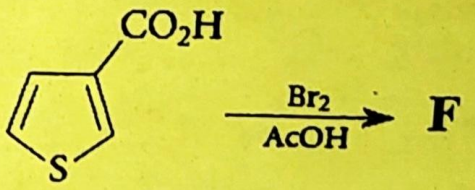
(f) Suggest appropriate synthetic methods for each of the following two-step transformation : 5



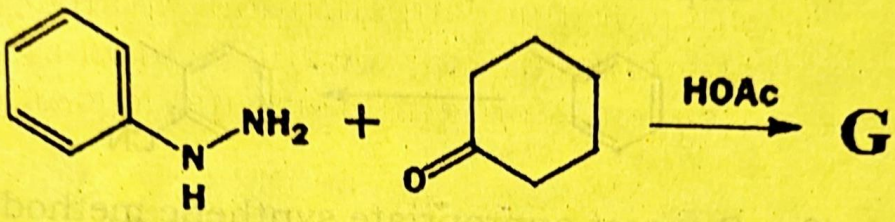
6. Answer ***any two*** from the following questions : 5×2=10

(a) *(i)* Arrange pyrrole, furan, thiophene and benzene in the order of reactivity towards electrophilic bromination. Give suitable reasons for your answer. 3

(ii) Predict the products of the following reaction with a suitable explanation. 2



(b) Predict the product of the following reaction and give a detailed explanation of the most suitable mechanism. 5



(c) Predict the product of the following thermal / photochemical reaction and provide a mechanism for the formation of the products. 5