MANIPAL ACADEMY of HIGHER EDUCATION
(Institution of Eminence Deemed to be University)

Reg.No.									

DEPARTMENT OF SCIENCES, III SEMESTER M.Sc. (Chemistry)
END SEMESTER EXAMINATIONS, NOV/DEC 2023

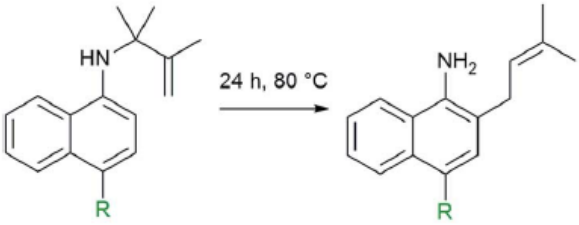
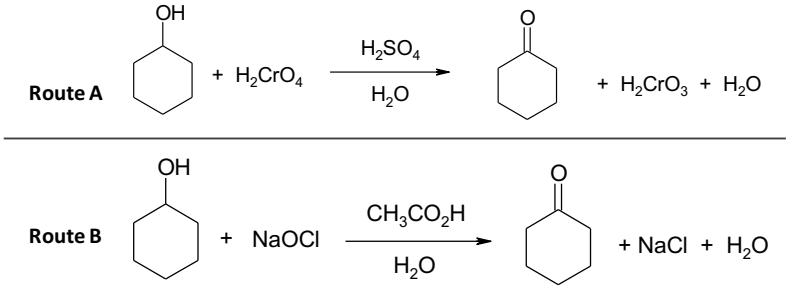
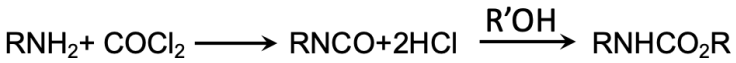
Green Chemistry [CHM 6006]

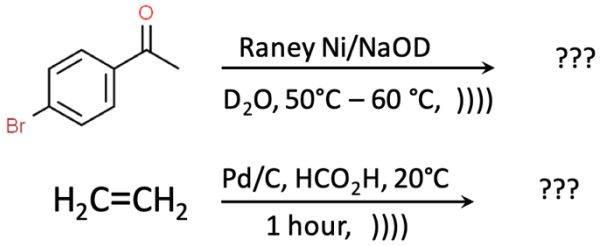
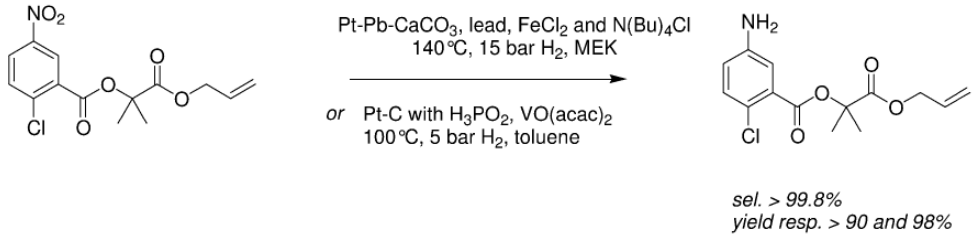
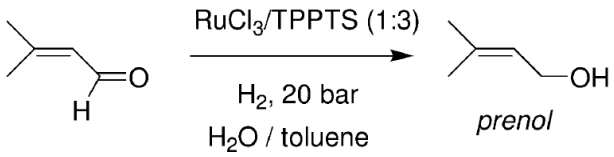
(CHOICE BASED CREDIT SYSTEM - 2021)

Time: 3 Hours Date: 02-12-2023 MAX. MARKS: 50

Note: (i)Answer **ALL** questions (ii) Draw diagrams and write equations wherever necessary

	Questions **(5+3+2) marks**	Marks	CO	BL
1	(a) What are the unique properties and advantages of zeolites? How does a catalyst influence the rate and activation energy of a chemical reaction? Explain the advantages of heterogeneous catalysis over homogeneous catalysis.	5	2	3
	(b) Why CO_2 is predominantly used in supercritical fluid extraction, instead of any other solvents/gases. Explain two industrial applications of supercritical CO_2?	3	2	3
	(c) Volatile organic substances in the environment is imposing a great problem to environment and health. As a Green Chemist, briefly discuss possible approaches in combating this problem.	2	2	3
2	(a) How is atom economy different from the yield of a reaction? Rank the following reaction in the order of most atom economical with justification. (i) isomerization of n-butane to isobutane and (ii) reaction of alkene with molecular chlorine. Do you consider the utilization of protecting (blocking) groups during the chemical synthesis as a green method or not? Justify your choice.	5	1	4
	(b) Give any one example of biocatalytic (enzymatic) processes describing the green synthesis of pharmaceuticals. Provide green synthesis routes of Adipic acid and Caprolactam.	3	1	4
	(c) How does olefin hydrogenation on Pt catalyst proceed? Describe the mechanism.	2	1	3

3	(a) Explain any five Green Chemistry principles in detail. Provide example for each principle with a reaction or a process or a method and compare with the conventional methods.	5	1	2
	(b) What are the advantages and disadvantages of using water as a solvent for synthesis?	3	1	4
	The yield of the below-mentioned rearrangement reaction is 100% when carried out in H_2O. But, the same reaction when conducted in D_2O (deuterated water) gives 40% yield. Identify the possible mechanism ("on water" or "in water") and explain reasons for lower yield in D_2O. 			
	(c) In below mentioned routes A & B to synthesize cylohexanone, which one is the *green* method & why? 	2	1	2
4	(a) Explain the advantages of using microwaves to realize the reaction over conventional synthesis methods in detail? Mention the safety precautions while executing the microwave-assisted reaction. Why is dimethylformamide (DMF) is considered as the choice of solvent compared to hexane for microwave synthesis. Why microwave reactors are not made of metals?	5	3	3
	(b) What are ionic liquids and mention their applications.	3	3	3
	In the below reaction to synthesize polyurethanes, comment on the possible approaches to make the reaction greener. 			

	(c) What are the advantages of electrochemical synthesis? Describe the process involved in electrochemical synthesis of Adiponitrile.	2	3	3
5	(a) What are the benefits of using biomass as a feedstock for chemical synthesis? Explain two examples where biomass waste is effectively utilized for synthesizing chemicals or value-added products or pharmaceutical ingredients. What is the relationship between the E-factor values and the greenness of a reaction? How do you relate? Explain?	5	2	3
	(b) Explain the principle involved in ultrasound-assisted green synthesis. What products are formed in the below reactions?  	3	2	4
	(c) Identify and explain the selectivity type involved in the following reactions. **Reaction #1**  *sel. > 99.8%* *yield resp. > 90 and 98%* **Reaction #2**  	2	2	4