



**Important
Instructions**

- There are FIVE questions printed in the question paper
- Answer all questions in the answer booklet only
- DO NOT use pencils for answering any part, even graphics
- Start answering each question from a fresh page, all sub-sections together

- Q.1.(a)** Cite the differences between the two common mechanisms for enzyme catalysis. [2M]
- (b)** Describe the differences between the different modes of operation of enzyme catalysis. [4M]
- (c)** What advantages are brought about by immobilizing enzymes? Describe any important enzyme immobilization approach. [3M]
- (d)** **(i)** How can you heterogenize $\text{PdCl}_2(\text{PPh}_3)_2$ complex in a purely siliceous microporous support matrix? Given that the microporous matrix has cage size of 12 \AA , and a window size of 8 \AA , while the size of the complex on the smallest dimension is 12 \AA **(ii)** How can you heterogenize the same complex on a mesoporous MCM-41 matrix? **(iii)** Can you immobilize Li^+ ions in any porous matrix? – Justify your answer with appropriate reasons. [6M]
- Q.2. (a)** Ruhrchemie/Rhône–Poulenc hydroformylation process for making butanals from propylene is a historical example of organometallic multiphase catalysis. Present a brief description of its multiphase nature and discuss how this is advantageously utilized to yield benefits. [3M]
- (b)** Describe the mechanisms of function of a PTC. [3M]
- (c)** **(i)** What are active and passive grafts in respect to functionalization of bulk catalyst surfaces? **(ii)** How is pillaring different from intralayer condensation for clays? **(iii)** Identify the following equations and mention how they are used ? [6M]
- $$\tau = \frac{K\lambda}{\beta \cos\theta} \quad \text{and} \quad r = \frac{2\gamma \cos\alpha}{p}$$
- (d)** Hysteresis loop cannot be obtained for a type I but may be obtained for type IV adsorptions isotherms – Justify your answer with respect to different materials involved herein respectively. [3M]
- Q.3. (a)** **(i)** Outline the process of tethering of a metal complex ML_n to zeolite NaY using a block diagram. **(ii)** Why are liquid crystals called so? How are their assemblies utilized for synthesis of porous matrices? **(iii)** How can you make mesoporous carbon starting from mesoporous silica? [6M]
- (b)** **(i)** How is incipient wetness different from wet impregnation as a technique? **(ii)** How are mass and heat transfer issues important for solid catalysts? [4M]
- (c)** Describe the catalytic cycle for Reppe process for MMA. [3M]
- (d)** What are the advantages of Cativa process over Monsanto process for acetic acid? [2M]
- Q.4. (a)** **(i)** Mention the major avenues available for bypassing the disadvantages of homogeneous catalysts in a reaction **(ii)** What are ROMP and RCM reactions? Discuss with examples. [6M]
- (b)** Describe the mechanism for DuPont adiponitrile process. [4M]

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(c) (i) What do you understand by the heterolytic catalytic oxygen transfer processes? (ii) Describe the function of the dual catalyst system for Wacker oxidation reactions using a catalytic cycle. [5M]

Q.5. (a) (i) Describe the advantages of organocatalysis over organometallic catalysis (ii) How would you conclude about the reaction steps in catalytic cycle of azide-alkyne Click reaction? (iii) What do you understand by reaction pocket? (iv) Discuss the electronic effects of a ligand on the coordinated metal centre with special emphasis to π -acid ligands. [9M]

(b) (i) Why are Ti, Nb, Zr etc. are used as metathesis catalysts involving M-alkylidene/ M-alkylidyne complexes? (ii) What is the justification of studying initial rates when study of overall reaction rate is definitely less cumbersome? (iii) We do not observe an induction period always even if we start a reaction using a catalyst precursor – Justify your opinion in this regard. [6M]

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