

Reg. No. :

Name :

Ph.D. ENTRANCE EXAMINATION, NOVEMBER 2022

FACULTY OF SCIENCE

CHEMISTRY

Time : 3 Hours

Max. Marks : 100

Instructions :

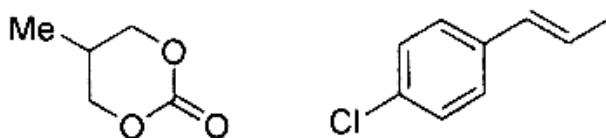
- 1) Answer **any ten** questions each from Section **A** and **B**.
- 2) Each question carries **5** marks.
- 3) No additional Answer sheets will be provided.
- 4) Candidates should clearly indicate the section, Question number in the answer booklet.

Section – A

Research Methodology

- I. Answer any **ten** questions. All Questions carry equal marks.
1. Describe the significance of chemical science databases in literature review. Name three chemistry databases that allow structure search.
2. Compare and contrast quantitative and qualitative research with suitable examples.
3. Describe the differences between a monograph and a journal.
4. Explain the terms :
 - (a) peer review
 - (b) open access publishing.

5. What are the common fire extinguishers used in a Chemistry lab? What fire extinguisher is suitable for fighting burning hexane and why?
6. What is MSDS? Why is it relevant for a research chemist?
7. Name an organic reaction that requires an anhydrous solvent. Explain why anhydrous THF containing sodium wire as a drying agent turns blue on addition of benzophenone?
8. What is self-plagiarism? Why is it an unethical practice?
9. What is atom economy? Name three reactions that are 100% atom economical.
10. How many regioisomers are possible for xylene? Draw their structures. How will you distinguish between them using ^{13}C NMR spectroscopy only?
11. Explain how you will separate a mixture of o-cresol and benzoic acid by solvent extraction.
12. Explain the following lab experiment with short accounts on procedure and mechanism: Conversion of phthalic anhydride to anthranilic acid.
13. Predict the number of signals and multiplicity of each signal in the ^1H NMR spectra of the following compounds. Explain your answer.



14. Explain the following terms from mass spectrometry
 - (a) FAB
 - (b) MALDI and
 - (c) TOF.
15. What is click chemistry? Describe its relevance.

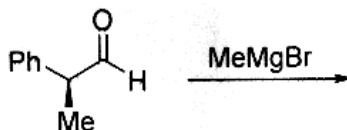
(10 × 5 = 50 Marks)

Section – B

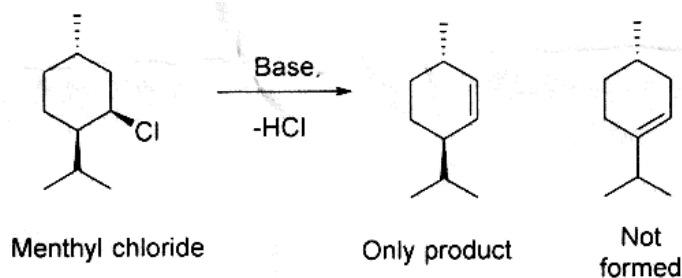
Chemistry

- II. Answer any **ten** questions. All Questions carry equal marks.
1. Describe briefly Jahn-Teller distortion. Distinguish between static and dynamic JT effect.
 2. Discuss on the various air pollutants and their harmful effects.
 3. Distinguish between Zinc blende and Wurtzite structure.
 4. Describe any one method for separation of lanthanides.
 5. (a) State variation principle.
(b) Discuss briefly commutative property with respect to uncertainty principle.
 6. Discuss Great orthogonality theorem and its consequences.
 7. Discuss probability distribution in MB statistics.
 8. (a) Using Debye – Huckel Limiting law, evaluate the mean ionic activity coefficient of 5×10^{-3} molar solution of ZnSO_4 .
(b) Using the activity coefficient obtained above, calculate the activity of the provided electrolyte solution.
 9. A liquid NMR Sample is placed in the magnet and excited with a frequency of 300 MHz. what would be the ratio (in ppm) between the excited and relaxed number of photon nuclear spins at 305 K? How will this ratio change (ppm unit) when the temperature is lowered to 275K?
 10. Explain Molecular orbital approach of Band Theory for a Li – Metal lattice.
 11. A solution contains Ligand L and Receptors R Receptors interact with ligand to form L:R complex with an association constant $K_a = 0.311$ at room temperature (298.2 K). When the temperature of the system is raised to 40° C, the standard Gibbs free energy change (ΔG°) is found to be +6.67 kJ. Assuming that ΔH° for the ligand: receptor binding in this experimental set-up does not change significantly between room temperature and 40°C, calculate the standard entropy change ΔS° for the reaction.

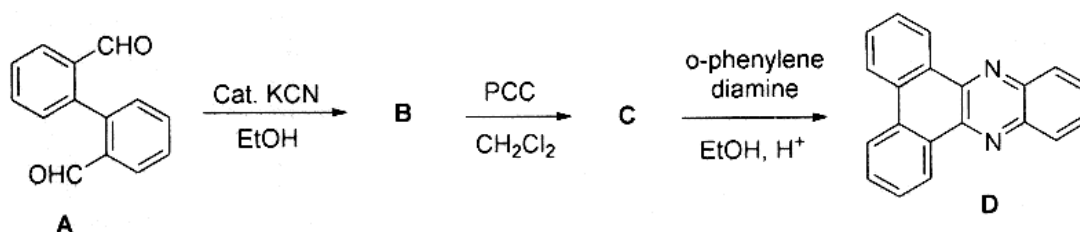
12. Predict the stereoselectivity of the following reaction using a suitable model.



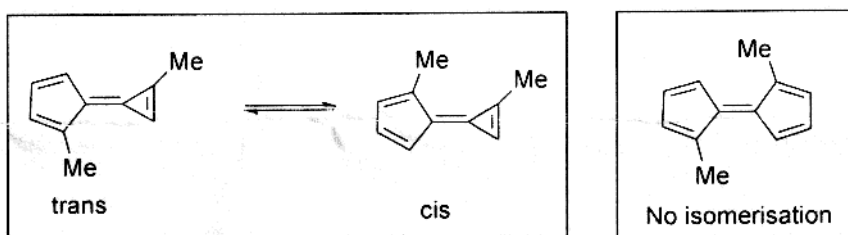
13. Explain with the help of conformational diagrams why dehydro chlorination of menthyl chloride produces a single regioisomer as shown below.



14. Identify B and C in the following synthetic sequence. Describe the mechanisms of formation of B and D.



15. One of the given compounds undergoes a facile cis-trans isomerisation while the other does not. Explain why?



(10 × 5 = 50 Marks)