

**INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR
DEPARTMENT OF CHEMISTRY**

Spring 2010-2011 End-Semester Examination

No. of Students: 616

Subject No./Name: CY11001 / Chemistry

Full Marks: 75

Time: 3h

(Please read all the instructions given below before answering the questions)

(This question paper contains five pages, including this page)

1. This Question Paper has TWO parts (PART-A and PART-B). Make sure that you have both PART-A and PART-B of the Question Paper.
2. Use SEPARATE ANSWER SCRIPTS for PART-A and PART-B.
3. WRITE your NAME, ROLL NO. and SECTION No. IN BOTH THE ANSWER SCRIPTS.
4. SUBMIT THE ANSWER SCRIPTS for PART-A and PART-B SEPARATELY to the invigilator on completion of the Examination.
5. WRITE ANSWERS SERIALY; OTHERWISE THEY WOULD NOT BE CHECKED.

Given Scientific Data:

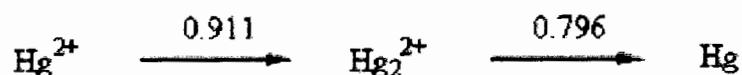
$R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$; $T = 298 \text{ K}$; $h = 6.626 \times 10^{-34} \text{ Js}$;

At. No.: Fe = 26, Co = 27, Cu = 29, Zn = 30, Rh = 45 and Hg = 80,

Part A: Inorganic Chemistry

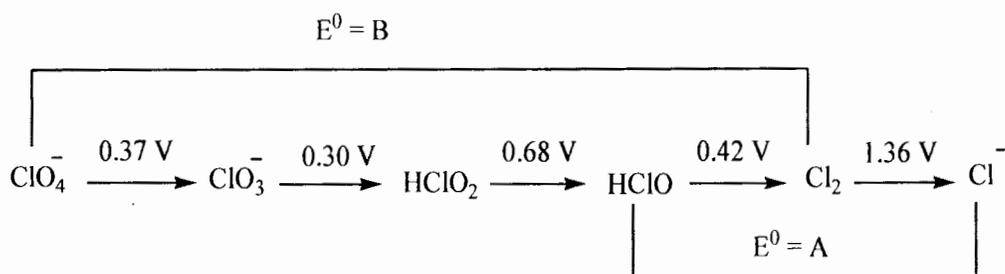
Answer all questions; 25 Marks

- Write the Schrödinger wave equation for hydrogen atom (1 mark)
- Draw the MO diagram for N_2^{2+} and O_2^{2+} ; fill in the electrons, and indicate the magnetic properties, and bond order for each molecular ion. (3+3 marks)
- Account the reason for the colour: $[Co(H_2O)_6]^{2+}$ is pale pink whereas the $[CoCl_4]^{2-}$ is deep blue. (2 marks)
- The magnetic moments of four octahedral complexes are given below. For each complex, draw the d-orbital splitting diagram with the electrons. Calculate the CFSE for each complex in terms of the octahedral splitting energy (Δ_o , $10 Dq$) and the pairing energy (P).
 - $[Fe(H_2O)_4(OH)_2]^+$, magnetic moment = 5.92 B.M.
 - $[Cu(NO_2)_6]^{4+}$, magnetic moment = 1.73 B.M.
 - $[Co(ox)_3]^{3-}$, magnetic moment = 0 B.M. (3 marks)
- Draw a Frost diagram for mercury in acid solution following the Latimer diagram:



Comment on the tendency of any of the species to act as an oxidizing agent, a reducing agent, or to undergo comproportionation. (3 marks)

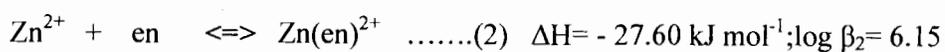
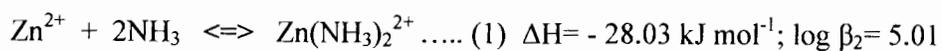
- Find out the reduction potentials, A and B, from the given diagram:



(2 marks)

7. Write the structure of Ca(II)-EDTA chelate in alkaline medium. (2 marks)

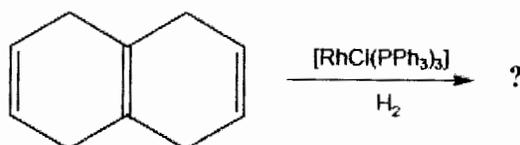
8. a) Calculate the entropy changes for the following reactions (1) and (2):



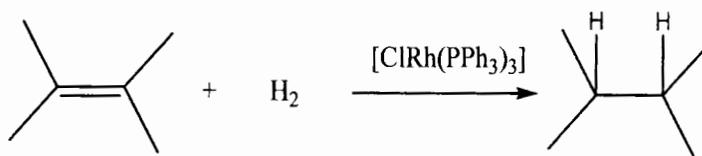
b) Provide your comment on the results.

(3 marks)

9. a) Find out the product of the reaction and identify the type of the reaction:



b) Consider the following reaction:



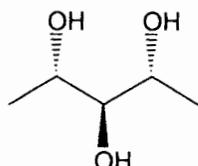
Identify the final step of the given reaction in the catalytic cycle by which the catalyst is regenerated (write equation). (1+2 = 3 marks)

*** Part A Ends Here***

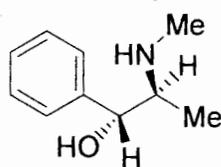
Part B : Organic Chemistry

Answer all questions (Total Marks: 50)

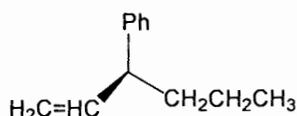
- 1) a) Depict the following molecule in Fischer projection. Find out the configuration at each of the chirality centers. 3 Marks



- b) Find out the configuration at each chirality centre for the following molecule 1 Marks



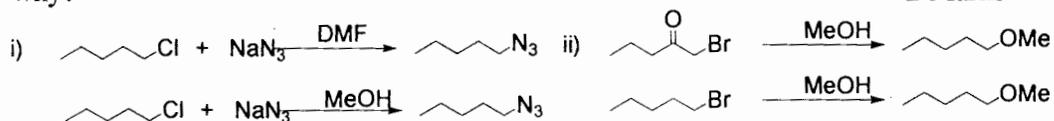
- c) What is possible change in the configuration of the chirality center of the following molecule upon reaction with H_2/Pd . Justify your answer. 2 Marks



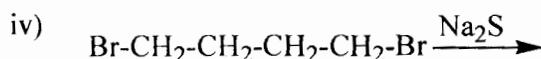
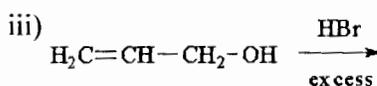
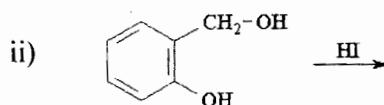
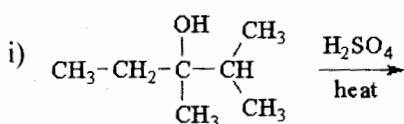
- d) i) An aqueous solution containing 10g of optically pure glucose was diluted to 500 mL with water and placed in polarimeter tube of 20 cm long. The measured rotation was -5.20° . Calculate specific rotation of glucose. ii) If the above solution was mixed with 500 mL of aqueous solution containing 5 g of racemic glucose, what would be the specific rotation of the resulting glucose mixture? What would be its optical purity? 4 Marks

- 2) a) Arrange the isomers of C_4H_9Cl in the order of decreasing rate of reaction with NaI in Acetone. 2 Marks

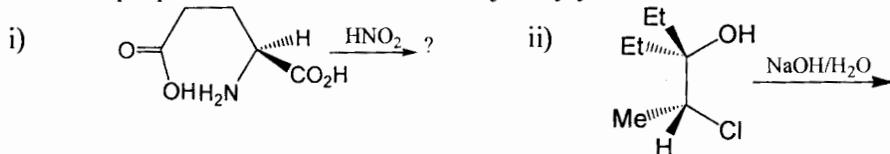
- b) Which reaction in each of the following pairs will take place more rapidly and why? 2 Marks



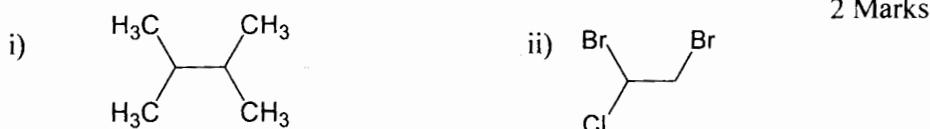
- c) What are the major products in the following reactions and indicate their mechanistic pathways? 8 Marks



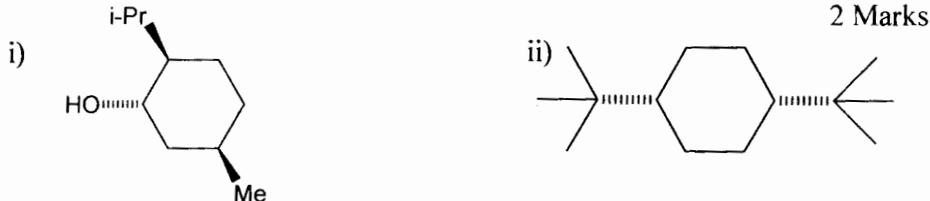
d) Predict the product with correct configuration at chirality centers for the following reaction. Also propose suitable mechanism to justify your answer. 8 Marks



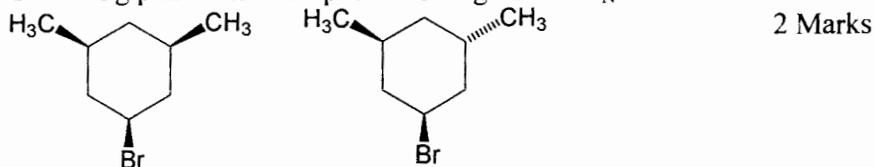
3) a) Draw the Newman projection for stable conformation of the following molecules. 2 Marks



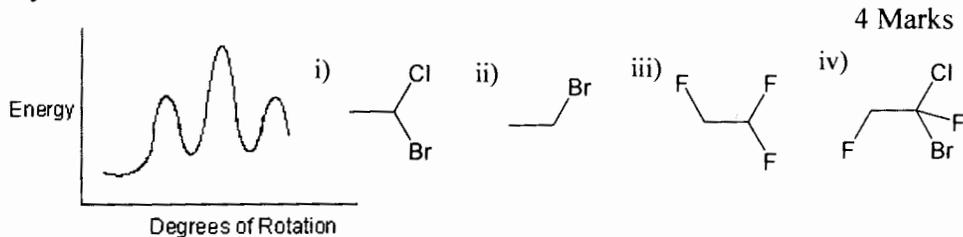
b) Draw the stable conformation of the following molecules 2 Marks



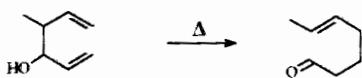
c) In the following pair which compound undergo faster S_N2 reaction. 2 Marks



d) Which of the following molecules would yield this energy profile drawing? Why? 4 Marks



4) a) Explain the mechanism of following reaction and state whether this reaction is reversible or irreversible. Justify your answer. 2 Marks



b) Explain with proper orbital pictures why [2+2] addition reactions are photochemically allowed and thermally forbidden 2 Marks

c) Suggest a mechanism (con or dis) for each transformation 6 Marks

