



Indian Association for the Cultivation of Science
(Deemed to be University under *de novo* Category)
Integrated Bachelor's-Master's Program
Mid-Semester Examination-Autumn 2024

Subject: Chemical Reactivity
Full Marks: 25

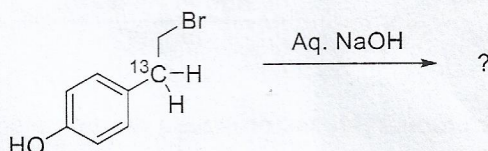
Subject Code(s): CHS 2101
Time Allotted: 2 h

Section A

1. Answer *any two* from the following questions.

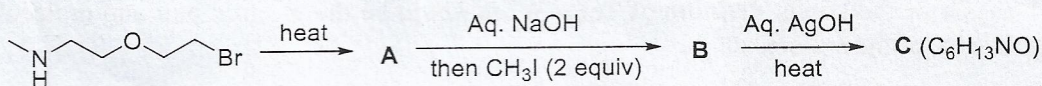
[2x2=4]

- a) Comment on the rate of hydrolysis of *tert*-butylbromide in 50% aqueous methanol and pure methanol.
- b) Predict the product(s) of the following reaction. Justify your answer.



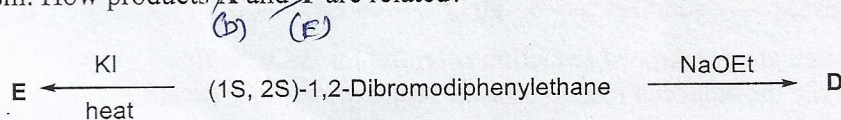
- c) Draw the structures of both *cis*- and *trans*-4-*tert*-butylchlorocyclohexane and explain why they undergo S_N2 reaction at same rate.
- d) Devise a mechanistic study to determine the involvement of a carbanion intermediate for 1,2-elimination reaction following $E1cB$ reaction pathway.

2. Predict the structure of **A-C** (major products) for the transformations below and justify your answer with proper reaction mechanism. [4]



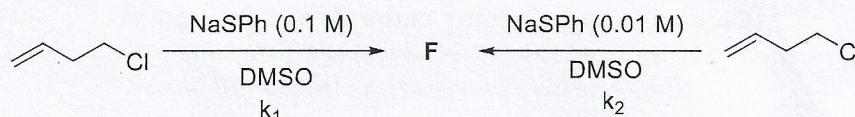
OR

Predict the major products **D** and **E** of the following reactions with proper stereochemistry and explain the origin of the stereoselectivity with a proper reaction mechanism. How products **X** and **Y** are related? [3+1]



3. Answer the following questions.

- a) Predict the structure of **F**. How rates (k_1 and k_2) of the following reactions are related? Provide explanation. [2]

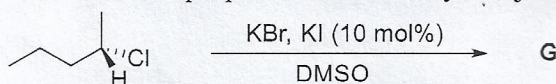


- b) When *sec*-butylacetate was heated at $> 200^\circ\text{C}$, different alkenes are formed. Predict the structure of the major alkene that would form in this reaction and provide a suitable reaction mechanism. [3]

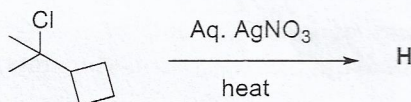
OR

Answer the following questions.

- a) Predict the structure of **G** with proper stereochemistry and justification. [2]



- b) Predict the major product (**H**) and propose a reaction mechanism for the below given reaction. [3]



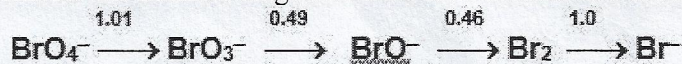
Section B

There are FIVE questions in this Section. Answer any FOUR.

4. (a) Draw the Lewis structure of TeF_4 . What would be the electron pair and molecular geometry of the molecule? [1.5]

- (b) Show the formation of HBrO_3 in the hydration-hydrolysis of Br^- ion in its correct oxidation state. Does the Br and O bonding match what was obtained from the Lewis structure? [1.5]

5. (a) Consider the Latimer diagram below for Bromine in a basic solution ($\text{pH} = 14$).



- (i) Calculate the skipped reduction potential for BrO_3^- to Br_2 . [1]
 (ii) Write the balanced reaction for the reduction of BrO_3^- to BrO_2^- . [1]
 (iii) Which species of bromine would undergo disproportionation? [1]

6. Using the Latimer diagram (see Q 5), Construct the Frost diagram for bromine species in ~~aqueous acidic~~ ^{basic} solution. Which species of bromine are unstable? [3]

7. (a) Draw the structure of dichlorobis(ethylenediamine)platinum(IV) chloride. What is the primary valency and secondary valency of platinum in the complex? How many stereoisomers are possible for this complex? [1.5]

(b) Show the d -orbital splitting in an axially compressed distorted octahedral complex. [1.5]

8. (a) On the basis of crystal field model, compare the magnetic properties of the complexes, $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{CN})_6]^{3-}$. [1.5]

(b) For $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$, the mean pairing energy is 23500 cm^{-1} and $10Dq$ is 13900 cm^{-1} . Comment on the spin state of the complex and calculate the CFSE. [1.5]

.....