KATHMANDU UNIVERSITY
End Semester Examination
January/February, 2025

Marks Scored:

Level : B.Pharm.
Year : I

Course : CHEM 104
Semester : II

Exam Roll No. :

Time: 30 mins.

11 FEB 2025

F. M. : 20

Registration No.:

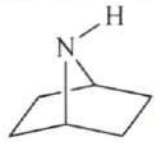
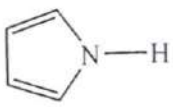
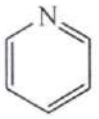
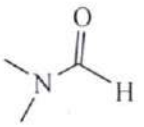
Date :

SECTION "A"

[20 Q. × 1 = 20 marks]

Choose and encircle in the most appropriate option from each set of choices

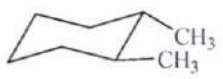
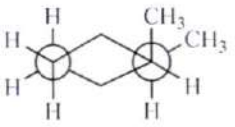
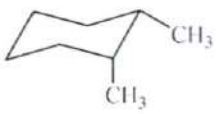
1. Which of the following structures exhibits an sp3-hybridized nitrogen atom?

[ ]  [ ]  [ ]  [ ] 

2. Which is the correct order of priority according to CIP rule to assign configuration?

[ ] –H > -CH_3 > -Cl > -CHO [ ] –Cl > -CHO >–CH_3 > -H
[ ] -Cl > –CH_3 > -CHO > -H [ ] –CHO > –Cl >–CH_3 > -H

3. All of the following are representations of cis-1,2-dimethylcyclohexane EXCEPT……

[ ]  [ ]  [ ]  [ ] 

4. A sample of 2-bromobutane has a specific rotation of +11.55. What is the approximate % of (+)-isomer in the sample? Given specific rotation of optically pure (R)-(-)-isomer is -23.10.

[ ] 20% [ ] 50% [ ] 75% [ ] 90%

5. Which mechanism involves a carbocation electrophile reacting with a weak nucleophile?

[ ] E1 [ ] E2 [ ] S_N1 [ ] S_N2

6. Potassium tertiarybutoxide (*t*-BuOK) is a suitable reagent to promote which mechanism/s?

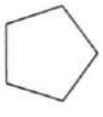
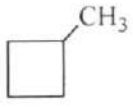
I. **S_N1** II. **S_N2** III. **E1** IV. **E2**

[ ] I and II [ ] I and III [ ] II and IV [ ] III and IV

7. Which of the following aromatic compounds is the most reactive toward Nitration?

[ ] Toluene [ ] Nitrobenzene [ ] Chlorobenzene [ ] Phenol

8. Which is expected to have the largest heat of combustion?

[ ]  [ ]  [ ]  [ ] 

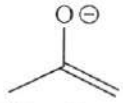
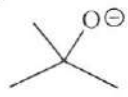
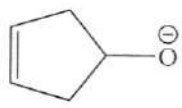
9. Which of the following statements is false about enantiomers?
[ ] rotate plane-polarized light [ ] are superimposable mirror images
[ ] are nonsuperimposable mirror images [ ] have the same melting point

10. Which of the following compounds may be classed as a polar aprotic solvent
[ ] N, N-Dimethylformamide [ ] Carbontetrachloride
[ ] Dichloromethane [ ] Diethylether

11. For a chiral substrate which of the following reaction mechanism is accompanied by inversion of configuration?
[ ] S_N1 [ ] S_N2 [ ] E1 [ ] E2

12. Nitration of toluene followed by oxidation with $KMnO_4$ yields..... as a major product.
[ ] o-nirtobenzoic acid [ ] m-nitrobenzoic acid
[ ] a mixture of o and p-nitrobenzoic acid [ ] m-nitrotoluene

13. Which of the following anions is resonance delocalized?

I  II  III 

[ ] I only [ ] II only [ ] I and III [ ] III only

14. Which compound below can react with two moles of alcohols to give an acetal?
[ ] Benzene [ ] Propanone [ ] Toluene [ ] Cyclohexene

15. How many stereoisomers are possible for a molecule of 2,3-dibromobutan-1-ol.
[ ] 1 [ ] 2 [ ] 3 [ ] 4

Fill in the blank.

16. Among the four conformations of n-butane, the most stable conformation is _____ conformation.

17. An electron withdrawing substituent at *ortho* or *para* position _____ reactivity of the benzene ring toward *electrophilic aromatic substitution.*

18. *Dehydrohalogenation* of 2-chlorobutane produces _____ as a major product.

19. Hoffmann elimination generally yields _____ substituted _____ as a major product.

20. Reaction of chlorobenzene with strong base such as sodium amide in ammonia undergoes nucleophilic aromatic substitution to give aniline. The mechanism of this reaction is elimination-addition mechanism which is also known as _____ mechanism.

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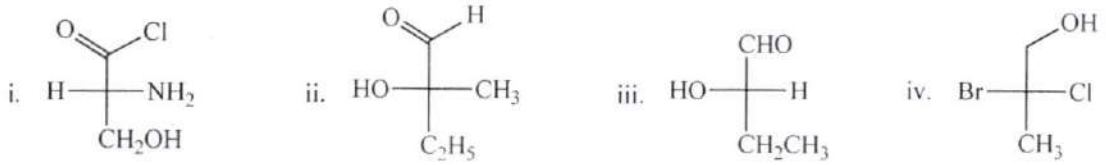
SECTION "B"

Attempt ALL questions.

1.

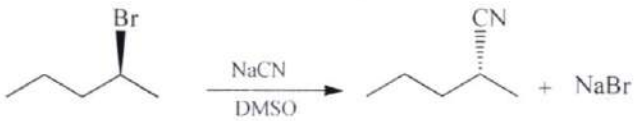
a. Write an example of each of the following name reactions. [3]
i. Fries rearrangement ii. Michael addition iii. Aldol condensation

b. Identify the R, S, configuration of the chiral center in each of the following compounds. [2]



2.

a. Consider the following substitution reaction.



i. Determine whether this reaction proceeds via an S_N1 or S_N2 process, and propose a complete mechanism [2]
ii. What is the expected rate equation for this process? [1]
iii. Would the process occur at a faster rate if the concentration of cyanide was doubled? [1]
iv. Draw an energy diagram for this process [2]

b. Explain the conformational analysis of cyclohexane. [4]

3. Give the appropriate reasons (*ANY SIX*) [2 × 6 = 12]
i. Cyclobutane is less stable than cyclopentane
ii. Neopentyl bromide undergoes nucleophilic substitution by S_N1 mechanism
iii. α-hydrogen is more acidic than other hydrogens in propanal.
iv. –Cl is a deactivating group for electrophilic aromatic substitution but ortho-para director.
v. Gauche conformation of n-butane is less stable than anti conformation.
vi. Cyclopentadienyl anion forms faster than cyclopentadienyl cation.
vii. Order of stability of free radicals is *tertiary* > *secondary* > *primary*.
viii. Generation of second chiral center yields diastereomers in unequal amounts.

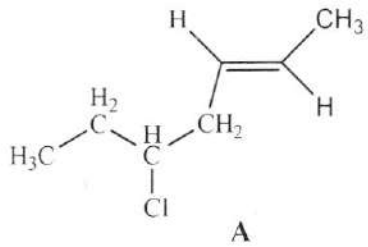
P.T.O.

4. Write short notes on *(**ANY THREE**)* [3 × 3 = 9]

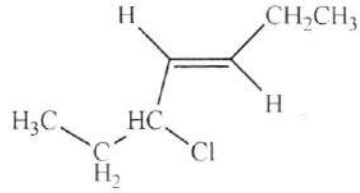
i. Resonance
ii. Resolution
iii. Conformational analysis of n-butane
iv. Cahn-Ingold-Prelog (CIP) rule

5.

a. The following isomers do not differ greatly in stability. Predict which one should react more rapidly in an S_N1 solvolysis reaction in aqueous acetone. Explain. [4]



A



B

6.

a. Give the major product/s for the following reactions. [5]

i. $C_6H_6 + Br_2 \xrightarrow{FeBr_3} ?$

ii. $C_6H_5Cl + NaNH_2 \xrightarrow{NH_3} ?$

iii. $C_6H_{10}(OH)(CH_3) \xrightarrow{C.H_2SO_4} ?$

iv. $2HCHO + C_6H_4(CHO) \xrightarrow{50\%\ NaOH} ?$

v. $C_6H_5CHO \xrightarrow[ii.\ H^+/H_2O,\ heat]{i.\ HCN} ?$

7. Propose a mechanism for the following reactions. [4 × 2.5 = 10]

i. $C_4H_6Cl(CH_3)_2 \xrightarrow{CH_3OH} C_5H_7(OCH_3)(CH_3)_2$

ii. $C_4H_7(CH_3) + HCl \longrightarrow C_4H_6Cl(CH_3)_2$

iii. $C_6H_6 + HNO_3 \xrightarrow{H_2SO_4} C_6H_5NO_2$

iv. $C_5H_{11}NH_2 \xrightarrow[2.\ Ag_2O,\ H_2O,\ heat]{1.\ excess\ CH_3I} C_5H_{10}$