

FYUGP/1st Sem/25(NEP)New

2025

Four Year Under Graduate Programme (FYUGP)

1st Semester Examination (Under NEP)

(New Session 2024-25)

CHEMISTRY (Major)

Paper Code : CEMMJ DC-101

(Organic Chemistry-I + Physical Chemistry-I)

Full Marks : 30

Time : Two Hours

The figures in the margin indicate full marks.

*Candidates are required to give their answers
in their own words as far as practicable.*

*Use separate answer script for
Organic Chemistry-I and Physical Chemistry-I.*

Group - A

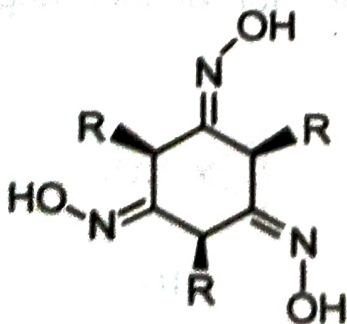
[Organic Chemistry-I]

(Marks : 15)

1. Answer any two questions :

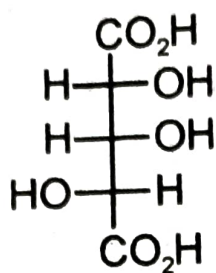
1×2=2

(a) Indicate symmetry elements present in the following molecule :

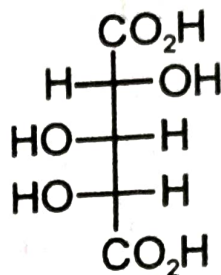


P.T.O.

- (b) Indicate whether the following two structures are homomers, enantiomers or diastereomers? Justify.

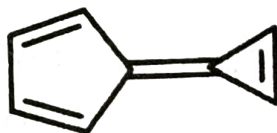


(A)



(B)

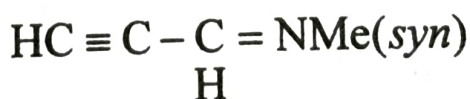
- (c) Why the following compound is highly polar in nature?



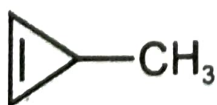
2. Answer any *three* questions :

2×3=6

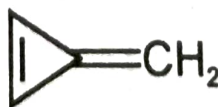
- (a) Draw the orbital diagram of the following compound indicating the state of hybridization of each atom clearly



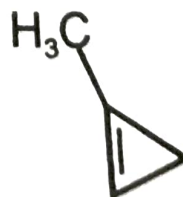
- (b) Write down the increasing order of heat of hydrogenation for the following compounds :



(I)



(II)



(III)

u) 11/12

(c) On reaction with anhydrous AlCl_3 methyl chloride does not produce methyl cation but CH_3COCl distinctly produces acyl cation — Justify.

(d) Between the two following molecules which has higher dipole-moment and why?



(e) Between the following two radicals which has higher bond-angle and why?



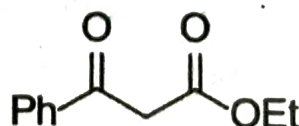
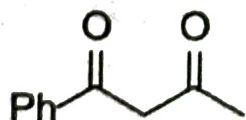
Methyl Radical

Trifluoromethyl Radical

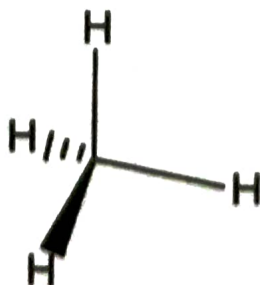
3. Answer any *one* question :

7×1=7

(a) (i) Between the following two molecules which has higher enol content and why?

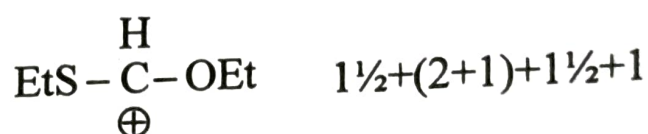


(ii) In the following molecule by operation show that there is an S_n axis of symmetry and hence it is achiral. Find the value of n .



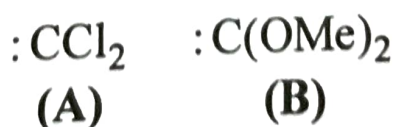
(iii) Draw all the stereoisomers (both optically active and optically inactive) of 2,3-dihydroxybutanoic acid and 3-chlorobutan-2-ol in Fischer projection formula. Show also the interrelation among these isomers (enantiomer and diastereomers).

(iv) Draw the canonical structures of the following cation and point out which one the most stable and why :



(b) (i) Find out two aromatic compounds from the Mol. Formula $\text{C}_6\text{H}_6\text{O}$ using double bond equivalence.

(ii) Explain while the intermediate (A) acts an electrophile the intermediate (B) behaves as a nucleophile :



(iii) Between allyl cation and allyl anion which one is more stable and why?

(iv) Between sec-butyl alcohol and iso-butyl alcohol which one show higher boiling point and why?

(5)

- (v) How can you establish the fact that cyclooctatetraene behaves as diradical?

$$1+2+1+1\frac{1}{2}+1\frac{1}{2}$$

Group - B

[Physical Chemistry - I]

(Marks : 15)

4. Answer any *two* questions :

$$1 \times 2 = 2$$

- (a) For a first order reaction what is the unit of A in Arrhenius equation?
- (b) If $z = f(x, y)$, then under what condition dz will be a perfect differential?
- (c) Write down the thermodynamic condition(s) for any gas to behave ideally.

5. Answer any *three* questions :

$$2 \times 3 = 6$$

- (a) From one-dimensional velocity distribution, find the average kinetic energy of a molecule.
- (b) Show that the work done in a reversible process is numerically greater than that in an irreversible process.
- (c) Calculate the time required in a first-order reaction when the final concentration of the reactant is $\frac{1}{e}$ times of the initial concentration.

P.T.O.

(d) Write the effect of temperature and pressure on mean free path (λ).

(e) With the help of an example explain what is meant by pseudo-first-order reaction.

6. Answer any *one* question :

7×1=7

(a) (i) Derive : $C_P = C_V + \left[P + \left(\frac{\partial U}{\partial V} \right)_T \right] \left(\frac{\partial V}{\partial T} \right)_P$.

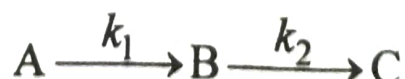
Using this equation calculate $C_P - C_V$ for a gas obeying $P(V - b) = RT$.

(ii) Plot Maxwell's distribution function for translational kinetic energy of gas molecules at two different temperatures. In the graph, depict the fraction of gas molecules possessing energies greater than a particular value.

(iii) A given mass of an ideal gas ($C_P = 5 \text{ cal deg}^{-1} \text{ mol}^{-1}$) at 27°C is compressed adiabatically reversibly to one-quarter of its volume. Calculate the temperature after compression.

3+2+2

(b) (i) For a consecutive first-order reaction



how much time will be required for the concentration of B to reach a maximum? What will be the maximum concentration of B?

(7)

- (ii) Draw the graph of concentration versus time of the three species A, B, C under the conditions (A) $k_1 \ll k_2$ (B) $k_1 \gg k_2$.
- (iii) Show that the adiabatic P-V curve of an ideal gas is steeper than the corresponding isothermal curve. 3+2+2
-