



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

Subject: Structure, Spectroscopy and Kinetics
Full Marks: 25

Subject Code(s): CHS1201
Time Allotted: 2 h

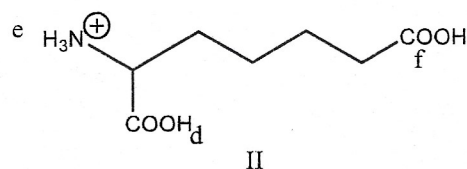
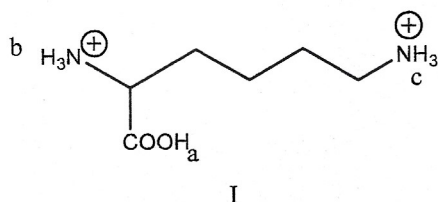
Part I: Physical Chemistry [12.5 marks]

1. Discuss Einstein's rate laws and derive an expression for A/B. [marks: 4]
2. Discuss the factors that impact the intensity of spectral lines. [marks: 3]
3. a) For CO molecule, the first line in the rotational spectra is found to be 3.83235 cm^{-1} . Find its rotational constant, moment of inertia and bond length. Assume rigid rotor. [marks: 2]

b) Calculate the ratio, N_1/N_0 , of molecules in the $J = 1$ and $J = 0$ rotational levels for carbon monoxide, CO, at 25.0°C . Assume a rigid rotor. Hint: at 25.0°C , $kT = 207.2 \text{ cm}^{-1}$. [marks: 2]
4. Comment (with reason) on the pure microwave and IR activity of: [marks: 1.5]
 - i) O_2
 - ii) CO_2
 - iii) NO

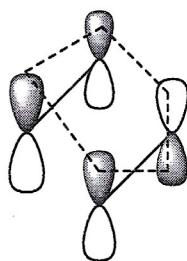
Part II: Organic Chemistry [12.5 marks]

1. Mention three factors that govern the pK_a of an organic acid. [mark: 1]
2. What is the difference between nucleophilicity and basicity? [marks: 2]
"A good nucleophile is always a good base". comment on this statement with example.
3. Find the order of removal of acidic hydrogens in each of the following molecules: [marks: 2]
(Write a brief explanation).

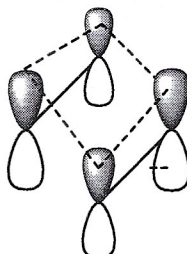


4. Which of the following transition states are aromatic?
The dotted lines show the orbital interactions.

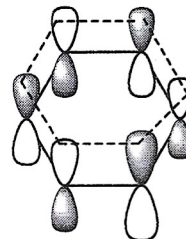
[marks: 2]



A

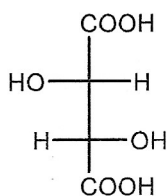


B

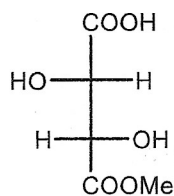


C

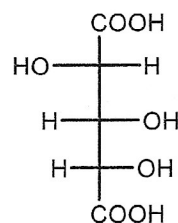
5. What is/are the minimum criterion/criteria for a molecule to be chiral? [marks: 1]
6. Which of the following molecules is asymmetric and which one is dissymmetric? [marks: 2]



X



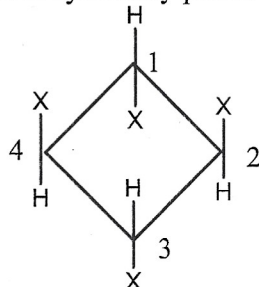
Y



Z

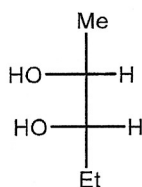
7. Find all the improper elements of symmetry present in the following molecule.

[marks:2]

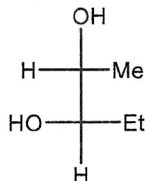


8. Which structure I-III is same as A?

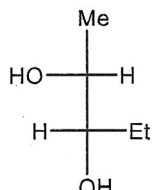
[marks: 0.5]



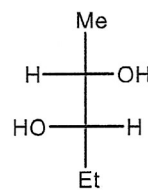
A



I



II



III