MANIPAL UNIVERSITY



Reg No

DEPARTMENT OF SCIENCES I SEMESTER M.Sc (CHEMISTRY) END SEMESTER EXAMINATIONS,

DEC 2016/JAN 2017

SUBJECT: ORGANIC SPECTROSCOPY [CHM 607]

REVISED CREDIT SYSTEM

Time: 3 Hours

Date: 03/01/2017

MAX. MARKS: 50

Instructions to Candidates:

Answer ANY FIVE FULL questions.

Write chemical equations wherever necessary.

- **1A.** Explain with example the identification of molecules possessing permanent dipole moment based on the symmetry aspects of a molecule.
- **1B.** What is Doppler broadening? Explain the various factors responsible for the intensity of the spectral lines.
- **1C.** Describe the general principle of Flame Photometry and Atomic Absorption Spectroscopy. Write the advantages of Atomic Absorption Spectroscopy over Flame Photometry.

2+4+4

- 2A. Distinguish the following
 i) C_{2v} and D_{2h} point groups
 ii) Symmetry element and symmetry operation
- **2B.** Draw a schematic diagram of the instrumentation involved in Atomic Absorption Spectroscopy and explain the function of each of the parts.
- **2C.** How are point groups classified? Determine the point groups of the given molecules by following the systematic procedure.
 - a) p-dichlorobenzene b) Naphthalene c) Cyclohexane (Boat form)

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- **3A.** Calculate the frequency, wavenumber and energy for a typical ultraviolet radiation of wavelength of 200 nm.
- **3B.** Describe the classification of molecules in Microwave Spectroscopy based on their moment of inertia equations. Calculate the inter nuclear distance of the molecule, if the pure rotational spectrum of the gaseous molecule CN consists of a series of equally spaced lines separated by 4.888 cm⁻¹. The molar masses are ${}^{12}C = 12.011$ g mol⁻¹ and ${}^{14}N = 14.007$ g mol⁻¹.
- **3C.** Prove that an odd order Sn axis generates 2n operations by taking eclipsed ethane as an

example and an even order Sn axis generates n operations by taking transdichloroethylene as an example.

- 4A. Define the following terms with a suitable example for each.i) Auxochromeii) Fermi resonance
- **4B.** What is responsible for the background absorption observed in Atomic Absorption Spectroscopy? Explain the background correction method and list two of it's limitations.
- 4C. i) How do you differentiate the following using Infrared Spectroscopy?
 a) Aliphatic and aromatic amines
 b) Cis and trans geometric isomers
 ii) Calculate the transmittance and molar absorptivity of KMnO₄ solution of 7.25 x 10⁻⁵ M, having an absorbance of 0.355 when measured in a 2.10 cm cell at a wavelength of 525 nm.
- 5A. Differentiate the following;i) Blue shift and red shift in UV-spectroscopyii) Single beam and double beam spectrophotometer
- **5B.** Describe the instrumentation involved in Raman Spectroscopy. Write two advantages of laser source over other sources.
- 5C. State and deduce Beer's law. Discuss the chemical deviations of it.

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- 6A. Calculate the approximate wave number of the fundamental absorption peak due to the stretching vibration of a carbonyl group. (The atomic masses of carbon and oxygen atoms are 1.99×10^{-26} kg and 2.66×10^{-26} kg. Force constant = 1×10^{-3} N/M).
- **6B.** Compute the λ_{max} for the following compounds based on the Woodward Fieser rules for diene.



- **6C.** i) Discuss the effect of polar and non-polar solvents on $n-\pi^*$ and $\pi-\pi^*$ transitions in UV spectroscopy.
 - ii) Give reasons for the following:
 - **a**) Symmetric stretching vibration of HCl is IR active however symmetric stretching vibration of CO₂ is IR inactive
 - **b**) Formaldehyde absorbs infrared radiation at 1750 cm⁻¹ whereas acetone absorbs at 1715 cm⁻¹.

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