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AC-233612

**M.Sc. (Semester-I)
Examination, Dec.-Jan. (2025-26)**

CHEMISTRY

**(Theory and Application
of Spectroscopy-I)**

Time Allowed : Three Hours

Maximum Marks : 70

Note : This question paper is divided into **four** sections.
Attempt questions of **all four** sections as per direction.
Distribution of marks is given in each section.

SECTION-A

(Objective Type Questions)

Note : Attempt **any ten** questions. Each question carries 1
mark. [10×1=10]

1. (i) Which of the following molecules exhibits a pure rotational microwave spectrum ?

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(1)

[P.T.O.]



- (a) N_2
- (b) CO_2
- (c) OCs
- (d) HCl
- (ii) What is the selection rule for transitions in the microwave spectrum of a rigid diatomic molecule ?
- (a) $\Delta J = 0$
- (b) $\Delta J = \pm 2$
- (c) $\Delta J = \pm 3$
- (d) $\Delta J = \pm 1$
- (iii) IR-spectroscopy it is not possible to know.....of substance.
- (a) Dipole moment
- (b) Molecular weight
- (c) Vibration mode
- (d) Atomic weight

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- (iv) Which principle does Nephelometry use ?
- (a) Decrease in transmitted light
- (b) Light absorption
- (c) Light scattering at a specific angle
- (d) Light emission
- (v) Electron diffraction is used primary to determine the :
- (a) Chemical composition of a material
- (b) Electron energy level
- (c) Crystal structure of materials
- (d) Mass of the electron
- (vi) A molecule that yield three rotational constants in if microwave spectrum is a.....
- (vii) Raman effect supports.....theory.
- (viii) According to the de-Broglie hypothesis the wavelength of an electron is inversely proportional to it.....

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- (ix) Identify the electromagnetic wave.....is also known as heat waves.
- (x) Raman frequencies are generally indicate with.....vibrational frequencies.
- (xi) Microwaves are produced by Klystrons.
(True/False)
- (xii) Wavelength selection is critical in nephelometry because the incident light is absorbed by the particles. (True/False)

SECTION-B

(Very Short Answer Type Questions)

Note: Attempt any five questions. Each question carries 2 marks. (Word limit : 25-30 words) [5×2=10]

2. (i) What is Electromagnetic Radiation ? Give example.
- (ii) What is selection Rule ?
- (iii) What is the Principle of Nephelometry ?

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- (iv) What is the difference between Raman and IR spectroscopy ?
- (v) Discuss the Stokes and AntiStokes line for Raman spectroscopy.
- (vi) What are the modes of Vibration in IR ?
- (vii) Calculate total number of Fundamental Vibration for CO₂ molecules.

SECTION-C

(Short Answer Type Questions)

Note: Attempt any five questions. Each question carries 4 marks. (Word limit : 250 words) [5×4=20]

3. (i) Describe modes of Vibration in Polyatomic molecules.
- (ii) Discuss the Born-Oppenheimer Helmer approximation.
- (iii) Discuss the Non-rigid Rotors.

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[P.T.O.]



- (iv) Discuss Classical and Quantum theories of Raman Spectroscopy.
- (v) Write short note on the Turbidimetry.
- (vi) Describe Instrumentation and Application of Auger Electron Spectroscopy.
- (vii) Explain Electromagnetic Radiation and Electron Energy Level.

SECTION-D

(Essay Type Questions)

Note: Attempt any three questions. Each question carries 10 marks. (Word limit : 500 words) [3×10=30]

4. (i) (a) Describe the effect of Isotropic substitution on Diatomic and Polyatomic molecules.
- (b) Explain Linear and Symmetric Top Polyatomic molecules.
- (ii) (a) Discuss Simple Harmonic Oscillators in Vibrational Spectroscopy.

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- (b) Write short note on Coherent Anti-Stokes Raman Spectroscopy (CARS).
- (iii) Describe principle, instrumentation and application of Nephelometry.
- (iv) Write short notes on the following :
 - (a) Scanning Electron Microscopy
 - (b) Rotation Raman Spectrum
 - (c) Fluorescence Spectroscopy

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