

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

December, 2019

MCH-003 : SPECTROSCOPIC METHODS

Time : 3 hours

Maximum Marks : 75

Note : (i) Attempt any five questions.
(ii) All questions carry equal marks.

Answer any five of the following :

3x5=15

1. (a) In what respects electromagnetic radiation is different from sound waves ?
(b) Give a schematic diagram for the energy levels for a molecule.
(c) Illustrate different molecular vibrations for a CO₂ molecule.
(d) Differentiate between Phosphorescence and Fluorescence with reference to its applications.
(e) FT-NMR is better than CW- NMR. Explain.
(f) What are isotopic peaks ? In what way are these useful ?

2. (a) Molecular absorption spectra are band spectra whereas Atomic absorption spectra are line spectra. Explain. 5
(b) Define Beer-Lambert's Law. The molar absorptivity of a substance is $2.0 \times 10^4 \text{ cm}^{-1} \text{ mol}^{-1} \text{ dm}^3$. Calculate the transmittance through a cuvette of path length 5.0 cm containing $2.0 \times 10^{-6} \text{ mol dm}^{-3}$ solution of the substance. 5
(c) Explain the principle of FTIR and give any two of its advantages. 5

3. (a) Explain the phenomenon of phosphorescence and fluorescence with the help of Jablonski diagram. 5
(b) How photoluminescence is related to structure ? Explain why pyridine is nonfluorescent but isoquinoline is fluorescent. 5
(c) Discuss the application of fluorimetry for the analysis of gaseous pollutants. 5

4. (a) Differentiate between atomic emission, atomic absorption and atomic fluorescence spectroscopy by giving a schematic diagram for each. 5
- (b) Draw the structure of flame showing various zones and explain important reactions when an analyte is put into it. 5
- (c) Explain the methodologies of quantitative analysis by flame photometry. 5
5. (a) Explain the different types of chemical interferences observed in flame photometry. 5
- (b) Discuss the analytical methodology for quantitative analysis using ICP-AES. What special advantages ICP-AES offers in the analysis of various materials? 5
- (c) What is fluorescence quenching method of analytical determination of the analyte? How is this method used for the analysis of fluoride from aquatic environment? 5
6. (a) List different types of atomic fluorescence transitions. Explain Stokes direct line fluorescence giving a schematic diagram showing the transitions involved. 5
- (b) Draw a schematic diagram of Hollow Cathode Lamp (HCL) illustrating different components. In what respects HCL differs from Electrodeless Discharge Lamp (EDL)? 5
- (c) What are the essential components of a typical Atomic Absorption Spectrophotometer (AAS)? Draw a schematic diagram of AAS. 5
7. (a) Explain the basic principle of flameless AAS and draw a schematic diagram of graphite furnace. How background absorption is handled in GFAAS? 5
- (b) Explain the role of organic solvents in AAS. What are the advantages of such solvents (list any two) over acidic-aqueous solvents? 5
- (c) Draw a schematic layout of different components of an ICP-AES spectrometer. Explain two steps of sample introduction briefly. 5
8. (a) What is meant by anisotropy of a chemical bond? Explain with the help of an example. 5
- (b) Explain Mc-Lafferty rearrangement taking the example of 2-Pentanone. 5
- (c) The main spectral details of an organic molecule having molecular formula, $C_3H_6O_2$ are as follows : 5
- Mass : (M/Z 29, 45, 57 and 74 (M^+))
- IR : (1700 cm^{-1} (strong); 3000 cm^{-1} (broad))
- NMR : ($\delta = 1.2(t)$, $\delta = 2.4(q)$, $\delta = 11.7(1H)$)
- Determine the structure of the molecule.
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