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MCH-003

P.G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

June, 2016

00847

MCH-003 : SPECTROSCOPIC METHODS

Time : 3 hours *Maximum Marks : 75*

Note : *Answer any **five** questions. All questions carry equal marks.*

1. Answer any ***five*** of the following : *5×3=15*

(a) Differentiate between reflection and refraction.

(b) What are the two models of electromagnetic radiation ? Write the units of wavenumber and frequency.

(c) Explain different types of electronic transitions involved in CH_3CONH_2 with the help of molecular orbital energy level diagram.

(d) Draw a labelled sketch of the flame structure indicating its different zones.

(e) Explain why tetramethyl silane (TMS) is used as a standard in NMR.

(f) Explain inductively coupled plasma (ICP).

2. (a) Explain charge transfer spectrum of a transition metal complex species by taking a suitable example. 5

(b) Differentiate between single beam and double beam spectrophotometers with the help of schematic diagrams. 5

(c) Describe the sampling procedure for solid samples in IR spectrometry. 5

3. (a) State and explain the rule of mutual exclusion with the help of a suitable example. 5

(b) A 5 mM solution of nickel complex was taken in a 1 cm cuvette. The absorbance at λ_{max} = 590 nm was found to be 0·45. Calculate the molar absorptivity of the solution. 5

(c) Explain the origin of phosphorescence and fluorescence with the help of Jablonski diagram. What are the possible spin states in a molecule ? 5

4. (a) Explain briefly the various factors affecting fluorescence and phosphorescence. 5

(b) Define bioluminescence. Write the reactions involved in this process. How is this phenomenon used for research in medical field ? 5

(c) Why do the phosphorimetric methods have limited applications in chemical analysis ? 5

5. (a) What is the role of atomizer in flame photometry ? Describe, in brief, the principle of total consumption burner. 5

(b) What are the various types of interferences observed in quantitative determination by flame photometry ? Explain each of these briefly. 5

(c) Explain the principle of atomic fluorescence spectrometry. What are its limitations ? 5

6. (a) Define nebulisation. Explain the fate of the sample in a flame. 5

(b) Explain the basic principle of atomic absorption spectrophotometry and the relationship between the analyte concentration and absorption. 5

(c) Discuss the use of organic solvent and microwave digestion in sample preparation in AAS determinations. 5

7. (a) Describe the analytical methodology in ICP-AES. What are the causes of spectral interferences in ICP-AES ? 5

(b) Draw Pascal's triangle. How is it useful in predicting relative intensities of split lines ? Write the possible spin orientations due to three protons of methyl group. *5*

(c) Explain how the signals due to chemical shift are differentiated from those due to spin-spin splitting. *5*

8. (a) What are the prominent peaks observed in the mass spectrum of $C_6H_5CH_2CH_3$ other than molecular ion peaks ? *3*

(b) An organic compound with molecular formula C_4H_8O shows the following spectral characteristics :

(i) Mass spectrum shows a molecular ion peak at 72 and other fragmentation peaks at m/z 57, 43, 29 and 15.

(ii) Intense absorption band at 290 nm in uv region.

(iii) Intense absorption band at 1720 cm^{-1} and a broad band at 3000 cm^{-1}.

(iv) NMR spectrum shows a triplet at about δ 2·3 and a quartet δ 1·2. Also a singlet is observed in between.

Interpret all the observations by assigning all the peaks and identify the compound with detailed structure. *12*
