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MCH-003

P. G. DIPLOMA IN ANALYTICAL CHEMISTRY (PGDAC)

Term-End Examination

June, 2019

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 : 3 each

   (a) A microwave radiation has a frequency of 15 GHz. Calculate its wavelength. ($h = 6.626 \times 10^{-34}$ Js).

   (b) Define and differentiate reflection and refraction with the help of an illustration.

   (c) How can IR spectroscopy be used to differentiate between aldehyde and ketone ?

   (d) Explain the term quantum yield and give its formula.

   (e) What are the merits and limitations of flame photometry ?

(f) Explain, why tetramethyl silane is used as a standard for chemical shifts in NMR spectroscopy.

2. (a) Draw a generalized molecular orbital diagram and show possible transitions for organic compounds. Explain by considering a suitable example. 5

(b) Explain the type and role of monochromators in UV-vis spectrometry. What type of sample holders are used for recording UV-vis spectra of liquid samples ? 5

(c) Briefly describe the techniques used for recording IR spectra of solids. 5

3. (a) Explain the phenomenon of chemiluminescence using the example of luminol. 5

(b) Draw a schematic layout of fluorimeter and give the light source used. 5

(c) Explain bioluminescence and discuss its significance in analysis. 5

4. (a) Explain the characteristics of atomic spectrum in terms of position of signal, its intensity and spectral line width. 5

(b) Explain various processes that occur in the flame when solution containing analyte is aspirated into it. 5

(c) What are different types of atomiser burners used in flame photometry ? Compare their performance. 5

5. (a) Describe various types of spectral interferences in quantitative analysis by flame photometry. Explain how these interferences can be corrected or eliminated. 5

(b) Explain the terms base peak, molecular ion peak and fragmentation. 5

(c) Explain direct and indirect methods of analysis by fluorescence. 5

6. (a) Explain the principle of Atomic Absorption Spectrophotometry (AAS). What is the importance of calibration plot in AAS ? 5

(b) What are the essential components of Atomic Fluorescence Spectrometer (AFS) ? Draw a block diagram of the AFS. 5

(c) Discuss the types of interferences encountered in atomic fluorescence spectrometry. Give its limitations. 5

7. (a) Why microwave digestion method is used in AAS ? Draw a schematic diagram of MDS. Enumerate various nebulisation methods used in AAS. 5

(b) Explain the principle of Atomic Emission Spectrometry (AES). What are the ideal atomisation excitation source characteristics ? 5

(c) Compare AAS and AES in terms of their advantages and disadvantages. 5

8. (a) Define chemical shift and explain why is it expressed in terms of ppm. 5

(b) Explain the features of NMR spectrum of ethanol in low resolution, high resolution of pure acidified and highly purified ethanol in details. Discuss the role of chemical exchange. 5

(c) The important spectral details of an organic molecule having molecular formula C_4H_8O are as follows :

Mass : (Prominent peaks at m/z 29, 43 (base peak), 57 and 72 (M^+)

IR : 2950 cm^{-1} (medium), 1718 cm^{-1} (strong), 1370 cm^{-1} medium)

NMR : δ = 0.92 (3 H, triplet); δ = 1.95 (2 H, singlet), and δ = 2.6 (3 H, quartet) Determine the structure of the molecule). 5