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UG/5th Sem/CHEM(H)/T/19

2019

B.Sc. (Honours)

5th Semester Examination

CHEMISTRY

Paper - DSE-2T

Full Marks : 40 Time : 2 Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Analytical Methods in Chemistry

Group - A

1. Answer any *five* questions out of eight carrying 2 marks each : 2×5=10

   (a) Distinguish between accuracy and precision.

   (b) What is determinate error ?

   (c) What is 'stationary phase' in an ion-exchange chromatography ?

[Turn Over]

(d) Define the term 'extraction coefficient'.

(e) What criterion is used in selecting an indicator for a particular acid-base titration ?

(f) How does solid-phase extraction differ from solvent extraction ?

(g) Why is a sharp line source desirable for atomic absorption spectroscopy ?

(h) What is the most common form of HPLC and why ?

Group - B

Answer any *four* questions out of six carrying 5 marks each: 4×5=20

2. (a) What is the retention time and the R_f value ? 2

(b) How does fast LC differ from conventional HPLC? 2

(c) What compounds can be determined by Gas chromatography (GC) ? 1

3. Describe the principles of fluorescence. Why is fluorescence generally more sensitive than absorption measurements ? Under what conditions is fluorescence intensity proportional to concentration ? 2+2+1

4. Describe the principles of flame emission spectrometry and atomic absorption spectrometry. 2½+2½

5. Describe two principal solvent extraction systems for metal ions. Give examples of each. 2+2+1

6. (a) Compare the operations of a single-beam spectrophotometer and a double-beam spectro photometer. 3

   (b) What are F-test and t-test ? 2

7. (a) Distinguish between a primary standard and secondary standard. 2

   (b) Calculate the energy, in calories, of one einstein of radiation at 3000Å. 2

   (c) The results of an analysis are 36.97 g, compared with the accepted value of 37.06 g. What is the relative error in parts per thousand ? 1

[Turn Over]

Group - C

Answer any *one* question out of two questions carrying 10 marks each : $10 \times 1 = 10$

8. (a) Explain the differences between cation-exchange resin and anion exchange resin. 2

   (b) Describe the principle and method of determination of total cation concentration in a given sample of water by ion exchange method. 3

   (c) In a paper chromatographic separation of Hg^{2+}, Pb^{2+} and Ag^{+}, the solvent front was 21 cm, while fronts due to these metals were 7, 14 and 18.5 cm, respectively. Calculate the R_f values of them. 3

   (d) In solvent extraction process, the extracting solvent is used in a number of parts instead of using the whole liquid in one lot — Explain. 2

9. (a) What do you mean by coefficient of variation ? 2

   (b) Using a proper relation, calculate the transmittance of a solution when its absorbance is 0.222. 2

(c) What do you mean by capacity and capacity factor in ion exchange ? 2

(d) Discuss the principle of liquid-liquid extraction and its important application. 4

Instrumental Methods of Chemical Analysis

Full Marks : 40 Time : 2 Hours

Group - A

1. Answer any *five* questions : 2×5=10

(a) What happens when a substance is irradiated with infrared radiations ?

(b) What do you mean by fundamental vibrations and overtones ?

(c) What is spin-spin spliting ? Define coupling constant (J).

(d) Write down the basic principles of Mass Spectrometry.

(e) Which type of nuclei show magnetic properties for the purpose of NMR Spectroscopy ?

(f) What do you mean by fluorescent radiation ?

(g) The wave length associated with an ultra-violet radiation is 285 nm. Determine the energy associated with it in Kcal/mole.

(h) What is Hooke's law ? Give its mathematical form.

Group - B

Answer any *four* questions 5×4=20

2. (a) What do you mean by monochromatic light ? How it can be obtained ? 2

(b) How thin layer chromatography is carried out ? 2

(c) What is meant by molar absorptivity ? 1

3. (a) An organic compound with molecular formula C_8H_6 decolourises bromine in carbon tetra chloride and gives a white precipitate with ammonical silver nitrate solution. Give the probable structure of the compound. Its IR spectrum gives a band at 2150 - 2200 cm^{-1} and the region near 3300 cm^{-1} is transparent. 3

(b) Explain Emission and Absorption spectra. 2

4. (a) Give a brief discussion on instrumentation of NMR spectrophotometer with a diagram. 2+1=3

(b) Discuss with an example how does UV technique help to distinguish equitorial and axial conformations ? 2

[Turn Over]

5. (a) What is the basic difference between supercritical Fluid Chromatography and Gas Chromatography? 2

   (b) How will you distinguish three isomeric butanols on the basis of mass spectrometry ? 2

   (c) Write down the most important source of IR light. 1

6. (a) What do you mean by chemical shift ? What are the factors that influence the chemical shift ? 1+2=3

   (b) Calculate the chemical shift in ppm (δ) for a proton that has resonance at 126 Hz downfield from TMS on spectrophotometer that operates at 60 MHz. 2

7. (a) Discuss with an example, how does IR spectroscopy help to make a quantitative estimation of an organic mixture ? 2½

   (b) How structural isomers can be distinguished by NMR spectroscopy ? Explain with an example. 2½

Group - C

Answer any *one* question : 10×1=10

8. (a) Describe the basic principles of Column Chromatography. 2

   (b) How do you explain that m/l 94 ion is formed in the mass spectrum of phenitol ? 2

   (c) How will you distinguish between inter and intra molecular hydrogen bonding on the basis of proton NMR spectroscopy ? 2

   (d) Give a schematic diagram for an FT-FR Spectrometer. 2

   (e) Discuss the positions of absorption of a particular band in a substance in all the three states. 2

9. (a) Compared to the number of bonds in a molecule, there are generally more number of peaks in the infra-red spectrum — Explain. 2

   (b) Write down the advantages of FT-IR method. 1½

(c) Predict the number of signals, their multiplicities and chemical shifts with respect to TMS as reference for the ^1H NMR spectrum of cinnamaldehyde. 3

(d) Do spin-spin coupling giving multiplets has any relation with coupling constant ? Explain. 1½

(e) Describe the procedure for separation of pigments present in leaves by column chromatography. 2