2022

5th Semester Examination

CHEMISTRY (Honours)

Paper : DSE 2-T

[CBCS]

Full Marks : 40 Time : Two 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

Answer any ***five*** from the following questions : 2×5=10

1. (a) Distinguish between Accuracy and Precision.

   (b) What is Q-test?

   (c) What are the fundamental laws of Spectroscopy?

   (d) Calculate the molar absorptivity of 0.4×10^{-3}M solution which has an absorbance of 0.15 when pathlength is 1.3 cm.

   (e) What are the basic differences between TGA and DTA?

   (f) What is the basic principle of pH metric titration?

P.T.O.

(g) What is the role of internal standard used in GLC technique?

(h) Good Precision does not assure good accuracy. — Explain the fact.

Group - B

Answer any ***four*** from the following questions : 5×4=20

2. (a) Differentiate between systematic error and random errors by giving suitable example.

   (b) The results of an analysis are 46.95 gm. Compared with the accepted value of 47.02 gm. What is the relative error in parts per thousand? 2+3

3. (a) The result of TGA analysis of a mixture of CaO and $CaCO_3$ indicates that mass of the sample decreases form 250.6 mg to 190.8 mg only between 600°C and 900°C. Calculate the percentage of calcium carbonate in the mixture.

   (b) What are the common sources of error in TG analysis? — Explain. 3+2

4. What is meant by the term R_f value? On what factors does the R_f value of a compound depend? What is the physical significance of $R_f = 0$ and $R_f = 1$.

5. (a) What is meant by racemic mixture of enantiomers?

   (b) A sample of S-(+) enantiomers of a compound has an observed rotation of + 19.2°. If the specific rotation of the pure enantiomer is + 24° then what

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is the optical purity of the sample? What is the composition of the mixture? 2+3

6. (a) What do you mean by thermogram?

   (b) What are the physical significance of the horizontal and the curved regions of a thermogram? 2+3

7. (a) Describe potentiometric method to determine the pH of a solution using the quinhydrone electrode.

   (b) Give an example of metallochromic indicator.

   (c) What is optical rotation? 3+1+1

Group - C

Answer any ***one*** from the following question : 10×1=10

8. (a) How is the standard deviation related to accuracy?

   (b) The following masses were recorded for 12 different coins (all given in grams)

   5.683, 5.549, 5.548, 5.552, 5.620, 5.536, 5.539, 5.648, 5.551,5.552, 5.554, 5.632

   Report the mean, median, range, standard deviation and variance for these data.

   (c) In what different ways a masking agent can help in achieving selectivity in metal ion separations? 2+5+3

P.T.O.

9. (a) What are the different types of detectors used in GC technique?

(b) How will you determine the equivalence point for each of the following combinations by conductometric titration?

(i) weak acid Vs strong base.

(ii) strong acid Vs weak base.

(c) Why IR spectroscopy is also called as the vibrational spectroscopy? What do you mean by fingerprint region in IR spectroscopy?

3+(2+2)+(2+1)

OR

[Instrumental Methods of Chemical Analysis]

Group - A

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

1. (a) What is spin-spin splitting? Define coupling constant (J).

(b) What KBr is used in IR spectroscopy?

(c) What is Reverse Phase Liquid Chromatography (RPLC)?

(d) State the energy range for IR, UV and flame emission spectroscopy?

(e) Which of the following atom is / are NMR active (^{12}C, ^{19}F, ^{2}H)?

(f) What is Red and Blue shift in UV-Vis spectroscopy?

(g) What is R_f value? Discuss its significance in chromatography separation.

(h) Name the detectors used in X-ray spectroscopy.

Group - B

Answer any ***four*** questions : 5×4=20

2. (a) What do you mean by chemical shift? Explain the factors influencing the 'Chemical shift'? 1+2

P.T.O.

(b) A compound with molecular formula, C_7H_7OCl shows three-proton singlet at δ 3.80, two proton doublet at δ 6.55 and also two proton doublet at δ 7.35. Identify the compound. 2

3. (a) Explain the differences between potentiometry and voltammetry. Draw cyclic voltammogram of *Ru*(II)/*Ru*(III) couple. 2+2

(b) What is most important source of IR light? 1

4. (a) Draw a block diagram of double beam UV-Vis spectrometer. Discuss with an example how does UV technique help to distinguish equatorial and axial conformations? 2+1

(b) The mass spectrum of 3-butyn-2-ol shows a large peak at m/z = 55. Draw the structure of the fragment and explain why it is particularly stable. 2

5. (a) What are the advantages of Fourier Transform in Infrared Spectroscopy? 2

(b) Name the electrodes used in potentiometry citing one example for each. 2

(c) What are the two types of pumps used in HPLC? 1

6. (a) Explain the working principles of Atomic Absorption Spectrometry (AAS). 2

(b) Outline how Mercury can be determined by Cold-Vapor AAS? 2

(c) What type of species can be separated by HPLC but not by GC? 1

7. (a) Indicate the order of elution of the following compounds from a reversed-phase packed HPLC column : 3

(i) benzene, diethyl ether, *n*-hexane.

(ii) acetone, Dichloroethane, acetamide.

(b) What are the applications of Molecular Mass Spectrometry? 2

Group - C

Answer any ***one*** question : 10×1=10

8. (a) Give a schematic diagram for a tandem mass spectrometer (MS/MS). 3

(b) What are the advantages of carbon ^{13}C NMR over proton NMR? 2

(c) Why tetramethyl silane (TMS) is used as internal standard in NMR spectroscopy? 2

(d) Write down the feasible structures of this compound : 3-methyl-2-butanol, m/z 43, 45, 71, 73, 88. 3

9. (a) Why pyrolytic graphite tubes are used in Graphite Furnace Atomic Absorption Spectrometry (GFAAS)? 2

P.T.O.

(b) How can you distinguish between phenyl acetate and methyl benzoate by IR spectroscopy? What types of cells are used for liquid samples in IR spectrometer? 2+1

(c) Explain Column is the heart of Gas Chromatography. 2

(d) What are the light sources used in fluorescence spectroscopy? 1

(e) How is DNA detected using gel electrophoresis? 2
