



B.Sc/5th Sem (H)/CHEM/23(CBCS)

2023

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** of the following : $2 \times 5 = 10$

1. R_f values of three amino acids X, Y and Z are 0.14, 0.38 and 0.72 respectively. Which one of these amino acids in their TLC separation will occur on the top and which one at the bottom? Explain your choice.
2. How will you define exchange capacity of a cation exchange resin?
3. Define the term 'chiral solvent'.
4. 'High degree of precision may not imply accuracy' — Justify.

P.T.O.

5. What are F-test and t-test?
6. Write down the limitations of 'Lambert-Beer's law'.
7. Explain the terms 'extraction by chelation' and 'extraction by solvation'.
8. Mention two fuel-oxidant gas mixture used for producing flame in atomic absorption spectrometer.

Group - B

Answer any **four** of the following : $5 \times 4 = 20$

9. (a) Draw the TGA thermogram of calcium oxalate monohydrate ($\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$) and hence explain its decomposition modes.
(b) Which factors are affecting TGA curves? $3+2$
10. (a) What is the main difference between Flame Emission Spectrometry and Atomic Absorption Spectroscopy?
(b) What special technique is used to determine mercury in water sample below the level of $\mu\text{g/L}$ by AAS? Discuss. $2+3$
11. (a) Discuss the theory of determination of composition of metal complexes by Job's method.
(b) What is the function of monochromator used in various spectrophotometer? $3+2$

12. (a) What are the main differences between single beam and double beam spectrophotometer?
(b) What is the isobestic point in spectrophotometry?
3+2
13. (a) Write a note on plate theory of chromatographic separation.
(b) (i) Define Enantiomeric Excess.
(ii) A sample of 2-bromobutane has an enantiomeric excess (e.e.) of 75% favouring the *d*-enantiomer. What is the percentage of each enantiomer?
2+(1+2)
14. (a) Describe potentiometric method to determine the pH of a solution using hydrogen electrode.
(b) Why spraying agent is required in the separation of ions through paper chromatography?
(c) What is thermogravimetry (TG) analysis? 3+1+1

Group - C

Answer any **one** of the following : $10 \times 1 = 10$

15. (a) The following values were obtained for the determination of cadmium in a sample of dust : 4.3, 4.1, 4.0, 3.2 $\mu\text{g/g}$. Should the value of 3.2 be rejected? (Given : Critical value of Q for a sample size of 4 is 0.831).

P.T.O.

- (b) What is derivative thermogravimetry?
- (c) Why *KBr* is used in IR spectroscopy?
- (d) Name any source of light for UV spectroscopy.
What do you mean by chromophore?

4+2+2+(1+1)

16. (a) Write down the difference between normal phase and reverse phase liquid chromatography.
- (b) Discuss the need of Zeeman background correction in flame atomic absorption spectroscopy.
 - (c) What are the functional groups present in cation exchange and anion exchange resins?
 - (d) What do you understand by column efficiency in chromatography?
 - (e) Absorptivity of ions will depend entirely on the relative charges and ionic radii of the two ions in ion exchange chromatography. — Explain.

2+2+2+2+2

(5)

OR

[Instrumental Methods of Chemical Analysis]

Group - A

Answer any **five** questions : $2 \times 5 = 10$

1. What do you mean by auxochrome and chromophore?
2. Calculate the corresponding energy in kcal/mol of an ultraviolet radiation having a wavelength (λ) of 3000Å.
3. Write down the relationship between absorbance and transmittance.
4. What happens when a substance is irradiated with infrared radiations?
5. How would you differentiate between X-ray emission and X-ray absorption processes?
6. Why molecular fluorescence usually occurs at a longer wavelength than the exciting radiation?
7. Why gel electrophoresis is called DNA fingerprinting?
8. How do you find the vibrational frequency of a bond using Hooke's law?

Group - B

Answer any **four** questions : $5 \times 4 = 20$

9. (a) Define the term bathochromic shift.

P.T.O.

- (b) The UV spectrum of an organic compound is sometimes called electronic spectrum. — Why?
- (c) McLafferty rearrangement cannot be used to distinguish between 2-pentanone and 2-hexanone. Criticize or justify. 1+2+2
10. (a) In NMR spectroscopy, TMS is added to the NMR sample whose absorption is set at zero. What is the reason for using TMS as standard?
- (b) How can you explain the fact that the value of chemical shift is constant irrespective of the magnetic field used in different instruments in recording NMR spectrum?
- (c) Discuss the “keto-enol” tautomerism of pentane-2,4-dione on the basis of observed signals in its NMR spectrum. 1+2+2
11. (a) Which type of solvents are usually used in chromatography?
- (b) Describe the procedure of separation of mixture of fluorescein and methylene blue by column chromatography.
- (c) How does the liquid rise through a paper chromatographic strip? 1+3+1
12. (a) Explain : CO_2 gives only four vibrational absorption peaks but CH_3Cl gives nine vibrational absorption peaks.

- (b) How would you differentiate an X-ray from the other types of electromagnetic radiations?
- (c) Briefly explain the basic applications of X-ray spectroscopic analysis. 2+1+2
13. (a) What is the difference between FID and TCD in gas chromatography?
- (b) Why CO_2 is used in supercritical fluid chromatography?
- (c) Describe the instrumentation of flame atomic absorption spectrometer. 2+1+2
14. (a) Explain the advantages of potentiometric titration.
- (b) Describe the basic principle of cyclic voltammetry.
- (c) What are the techniques used in radiochemical separation? 2+2+1

Group - C

Answer any **one** question : 10×1=10

15. (a) Explain fingerprint region in IR spectra.
- (b) Explain the appearance of $m/z = 44$ in the mass spectrum of $CH_3CH_2CH_2CHO$.
- (c) Describe the instrumental arrangement of NMR spectrophotometer with a schematic diagram.

P.T.O.

- (d) The two isomers of 1,2-dibromoethenes exhibit proton resonance at δ 6.62 and δ 7.03. Identify which signal belongs to which isomer and explain.
- (e) Draw the structure of an optically active compound $C_5H_{10}O$ with an IR absorption band at 1730 cm^{-1} .
1+2+3+2+2

16. (a) Explain the terms fundamental vibration and overtone.
- (b) How will you distinguish *o*-nitrophenol and *p*-nitrophenol on the basis of IR spectroscopy?
- (c) Mention the advantages of FT-IR spectroscopy.
- (d) Discuss two major applications of Atomic Absorption Spectroscopy (AAS).
- (e) With the aid of a diagram, explain how an X-ray is diffracted by a crystalline substance.

2+2+2+2+2

