

2025

CHEMISTRY — HONOURS

Paper : DSE-A-4

(Analytical Methods in Chemistry)

Full Marks : 50

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer *question no. 1* and *any eight* questions from *question nos. 2* to *13*.

1. Answer *any ten* questions : 1×10
- (a) Name the functional group present in a strong cation exchange resin.
 - (b) What is Nujol?
 - (c) Write down the equations showing the relation between percentage extracted (%E) and distribution ratio (D).
 - (d) Mention the fuel and oxidant of a flame providing highest temperature in a flame photometer.
 - (e) Mention the SI unit of specific conductance and equivalent conductance.
 - (f) Write the expression for calculating the enantiomeric excess (ee).
 - (g) What is a thermogram?
 - (h) Name one computer software used in the automation of laboratory processes.
 - (i) Why Beer's law is called a limiting law?
 - (j) Name a detector used in Gas chromatography.
 - (k) What will be the indicator electrode in the potentiometric titration of standard KCl solution against AgNO₃ solution?
 - (l) What is the principal difference between a double beam spectrophotometer and a single beam spectrophotometer?
2. (a) How to estimate Ca²⁺ and Mg²⁺ ions in a mixture of their corresponding oxalates by thermogravimetric analysis? 3+2
- (b) Mention the sample characteristics that affect the TGA.
3. (a) Mention one chemical interference in AAS and how it can be eliminated.
- (b) State the two basic differences between atomic absorption and atomic emission spectroscopy. 3+2

Please Turn Over

(1922)

4. (a) 96% of a solute is removed from 100 mL of an aqueous solution by extraction with two 50 mL portions of an organic solvent. What is the distribution ratio of the solute?
(b) Why is TMS a good reference compound in NMR spectroscopy? 3+2
5. (a) A compound of formula weight 280 absorbed 65.0% of the radiation at a certain wavelength in a 2 cm cell at a concentration of 15.0 $\mu\text{g/mL}$. Calculate its molar absorptivity at the wavelength.
(b) Cis-cinnamic acid absorbs at 268 nm ($\epsilon = 10,700$) while trans-cinnamic acid absorbs at 272 nm ($\epsilon = 15,900$). Explain the hypsochromic shift in the UV-spectrum of the cis-isomer with respect to the trans-isomer. 3+2
6. (a) How will you estimate the Ca^{2+} ions in trace level by AAS?
(b) Mention the source material and monochromator used in IR spectrophotometer. 3+2
7. (a) Write down the basic principle for the determination of composition of metal complexes using mole ratio method.
(b) Write two points of difference between LC and HPLC. 3+2
8. (a) In a paper chromatographic separation of Hg^{2+} , Pb^{2+} and Ag^+ , the solvent front was 21 cm while fronts for these metals were 7, 14 and 18.5 cm, respectively. Calculate the R_f values of these ions.
(b) In conductometric titration, it is preferable to titrate AgNO_3 with LiCl solution rather than with HCl solution. Explain. 3+2
9. (a) Outline the basic components of a double-beam IR spectrometer with the help of a diagram.
(b) Name two chiral shift reagents in GC and HPLC. 3+2
10. (a) State the principle of conductometric titration with the help of an example.
(b) Predict the number and give the names of the fundamental modes of vibration of hydrogen chloride. 3+2
11. (a) Define 'number of theoretical plates' with respect to column chromatography. How does it affect the column efficiency?
(b) If for a chromatographic column of length 30 cm, the theoretical plate height is 30 μm , find the number of theoretical plates. 3+2
12. (a) Name two principles of solvent extraction system for metal ions and describe the mechanism of any one of them.
(b) What is a Hollow Cathode Lamp (HCL)? What is its use in AAS? 3+2
13. (a) Explain a technique used for the determination of pK_a value.
(b) The vibrational frequency of water is found to be higher than D_2O . Explain. 3+2