

2022

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.*

1. Answer **any ten** questions : 1×10
- Give an expression for molar absorptivity. Mention its unit.
 - What do you understand by bathochromic shift?
 - State a common source of IR radiation.
 - What do you mean by enantiomeric excess (ee)? Give a mathematical expression.
 - Define ion exchange capacity.
 - What is the major disadvantage of the hollow cathode lamp in AAS?
 - What is a calomel electrode?
 - Why is plasma used in AES?
 - Give two examples of compounds which are used to prepare pellet in FTIR spectrometry.
 - State one advantage of Dropping Mercury Electrode (DME) in polarography.
 - Define the term 'retardation factor (R_f)' with respect to paper chromatography.
 - In a computer based analytical instrument, name the characteristic that gets converted to digital signal.

Answer **any eight** questions.

- Draw the nature of curves expected for the conductometric titration of acetic acid vs ammonium hydroxide. Explain the nature of curve and comment on the equivalence point(s).
 - Aniline, when reacted with picric acid, gives a derivative having molar absorptivity of $134 \text{ cm}^{-1} \text{ g}^{-1} \text{ L}$ at 359 nm. What would be the absorbance of a $1.0 \times 10^{-4} \text{ M}$ solution of that aniline derivative in 1.0 cm cell? 3+2
- Outline the basic components of a double beam IR spectrometer with the help of a diagram.
 - Predict the number and give the names of the fundamental modes of vibrations of hydrogen chloride. 3+2

Please Turn Over

4. (a) List and explain the spectral interferences that are encountered in atomic absorption methods.
(b) What are the basic differences between atomic absorption and atomic emission spectroscopy? 3+2
5. (a) How a glass electrode is prepared? How concentration of H^+ in a solution can be measured using this electrode?
(b) What are ion selective electrodes? Mention an important use of ion selective electrodes. 3+2
6. (a) Sketch the TGA curve for $CuSO_4 \cdot 5H_2O$, explaining the relevant changes with suitable equations.
(b) The TG curve of a 2.89 mg sample containing $MgSO_4 \cdot 7H_2O$ (mol.wt.246) exhibited a weight loss of 0.59 mg at a temperature of $105^\circ C$ corresponding to the reaction
- $$MgSO_4 \cdot 7H_2O(s) \rightarrow MgSO_4 \cdot H_2O(s) + 6H_2O(g).$$
- Calculate the percentage of $MgSO_4 \cdot 7H_2O$ in the sample. 3+2
7. (a) What is the % enantiomeric excess of the mixture containing 12.8 mol (R)-2-bromobutane and 3.2 mol (S)-2-bromobutane?
(b) How will you prepare a liquid sample for IR spectrophotometry? 3+2
8. (a) Outline two important applications of thin layer chromatography (TLC). Give one reason for stating that TLC is considered better technique than paper chromatography.
(b) What is the importance of a spraying agent in chromatography? Name two such reagents in the detection of amino acids. 3+2
9. (a) What are ion exchangers? Illustrate with equations how a cation exchanger and an anion exchanger works.
(b) Name two metal chelating agents and draw their structures. 3+2
10. (a) What are the principle differences between conventional liquid chromatography systems and high performance liquid chromatography (HPLC) systems?
(b) In what order would the following compounds be eluted from an alumina column using n-hexane as an eluting agent and why? CH_3CH_2OH , CH_3CHO and CH_3COOH . 3+2
11. (a) Discuss the factors which lead to interference with the determination of the concentration of a given element by flame emission spectroscopy. How can this interference be reduced?
(b) Outline the principle of countercurrent extraction. 3+2
12. (a) Explain the main difficulty in transmitting instrument data output to a computer. How can one overcome it?
(b) Discuss the application of chiral lanthanoid-induced shift reagents to determine the enantiomeric purity of optically active cations. 3+2
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