KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Level : B.Sc.
Year : III
Time : 2 hrs. 30mins.

18 AUG 2024

Course : INAN 301
Semester : I
F. M. : 55

SECTION "B"
[5 Q. × 3 = 15 marks]

*Attempt ANY FIVE questions.*

1. A least square analysis of calibration data for the determination of lead based on its flame emission spectrum yielded the equation $S = 1.15C_{Pb} + 0.315$. Where, $C_{Pb}$= Concentration of Pb in parts per million (ppm). S= measure of the relative intensity of the lead emission line. Calculate (a) the calibration sensitivity (b) the Analytical sensitivity at 10ppm of Pb (c) the detection limit. [3]

| Conc. ppm Pb | No. of replication | Mean value of S | S.d (s) |
|---|---|---|---|
| 10.0 | 10 | 10.92 | 0.12 |
| 1.00 | 10 | 1.21 | 0.035 |
| 0.00 | 24 | 0.0286 | 0.0071 |

2. A solution that was $3.78\times10^{-3}$ M in X had a transmittance of 0.212 when measured in a 2.00 cm cell. What concentration of X would be required for the transmittance to be increased by a factor of 3 when 1.00 cm cell was used? [3]

3. Indicate whether the following vibrations are active or inactive in the IR spectrum. [6×0.5=3]

| | |
|---|---|
| $CH_3$- $CH_3$ | C-C symmetrical stretching |
| $CH_3$- $CCl_3$ | C-C asymmetric stretching |
| $SO_2$ | asymmetric stretching |
| $CH_2$=$CH_2$ | $CH_2$ wagging |
| $CO_2$ | symmetric stretching |
| HCl | symmetric stretching |

4. List the advantage possessed by deuterium lamp over hydrogen lamp. Why Beer's law is also called a limiting law? [1.5+1.5]

5. What do you mean by chemical interference? When are releasing agents and protective agents used? [3]

6. Calculate the Larmor frequency (in MHz) for protons in magnetic field of 4.69T ($\gamma=2.68X10^{8}T^{-1}S^{-1}$). [3]

7. Suggest the structure of a compound with molecular formula $C_{10}H_{12}O$, which gives peaks at m/e 15, 43, 91, 105, 148 [3]

**P.T.O.**

## SECTION "C"

[5 Q. × 5 = 25 marks]

*Attempt ANY FIVE questions.*

8. What are different sample atomization techniques in AAS? Illustrate the process which occurs during flame atomization. At what condition the flame is stable. [1.5+2.5+1]

9.
   a. What are the different types of environmental effects on NMR spectra? [3]
   b. What are mobile phase and stationary phase in chromatography? [2]

10.
   a. Explain about charge transfer absorption in UV Visible region. Why it is important for quantitative purpose? [3]
   b. Differentiate between adsorption and partition chromatography. [2]

11.
   a. In chromatography, what are the variables that lead to zone broadening? [3]
   b. Predict the proton NMR spectra for highly purified ethanol. [2]

12.
   a. What is meant by temperature programing in GC? Why is it frequently used? [3]
   b. What are the effects of stationary phase film thickness on GC? [2]

13. Write about Ion chromatography. What type of chemical species can be separated by HPLC but not by GC? [3+2]

14. Draw block diagram of GC. Write about injectors used in HPLC. [2+3]

## SECTION "D"

[2 Q. × 7.5 = 15 marks]

*Attempt ANY TWO questions.*

15.
   a. Write about electron capture detector (with well labelled diagram). [4]
   b. Write short note on sample handing technique in IR. [3.5]

16.
   a. Write Describe different types of ion sources used in mass spectrometer, with advantages and disadvantages of each. [5]
   b. Write short note on role of solvent in UV visible spectroscopy. [2.5]

17.
   a. Define [2+2]
      (i) First-order NMR spectra (ii) Coupling constant
   b. What is significance of distribution constant in chromatography? [3.5]

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SECTION "A"
[20 Q. × 1 = 20 marks]

**Choose and encircle in the most appropriate option from each set of choices**

1. Which of these statements is **TRUE**?
   [ ] Gravimetric analysis involves measurement of volume
   [ ] Conductometry and potentiometry are examples of classical analytical methods
   [ ] The characteristic property for polarography is electrical potential
   [ ] The characteristic property for UV Visible spectrometry is absorption of radiation

2. Which of these statements is **NOT** true?
   [ ] The data domain for transduced information for atomic emission spectrometer is electrical current
   [ ] The information sorter for flame photometer is filter
   [ ] The stimulus for mass spectrometer is the ion source
   [ ] Hydrogen ion activity is the analytical information for coulometer

3. The type of quantum transition in the region $1\times10^6$ to $5\times10^4$ $cm^{-1}$ wave number is
   [ ] Nuclear
   [ ] Inner electrons
   [ ] Bonding electrons
   [ ] Rotation/ vibration of molecules

4. How does increasing the path length of the cuvette affect the absorbance in UV-Vis spectroscopy?
   [ ] Absorbance decreases
   [ ] Absorbance increases
   [ ] Absorbance remains unaffected
   [ ] Absorbance become negative

5. Which of the following transition is possible for propane?
   [ ] $\sigma \rightarrow \sigma^*$ [ ] $\Pi \rightarrow \Pi^*$ [ ] $n \rightarrow \sigma^*$ [ ] $n \rightarrow \Pi^*$

6. Rank the following bonds in order of decreasing stretching frequency ($cm^{-1}$) in IR spectrum.
   [A]O-H (alcohols) [B] C=O (ketones) [C] C-N (amines) [D] C-H (alkanes)
   [ ] A<D<B<C [ ] C<B<A<D [ ] B<A<C<D [ ] D<C<B<A

7. Identify the molecule having molecular ion peak at m/z=58, an IR absorption peak at 1650 $cm^{-1}$ and one singlet peak in $^1H$ NMR spectrum.
   [ ] $CH_3CH_2$ $CH_2CH_3$
   [ ] $CH_3COCH_3$
   [ ] $CH_3CH_2CHO$
   [ ] $CH_3CH(CH_3)CH_3$

8. Which of the following indicated proton has the highest chemical shift?
   [ ] $C\underline{H}_3OH$ [ ] $C\underline{H}_3F$ [ ] $C\underline{H}_3I$ [ ] $CH_4$

9. _____ Column has highest sample holding capacity.

[ ] Wall Coated Open Tubular
[ ] Surface Coated Open Tubular column
[ ] Packed column
[ ] Fused Silica Wall Coated Open Tubular

10. Which of the following statement accurately describes the electron impact ion source?

[ ] Ionizing agent is the reagent gas ions
[ ] Only molecular ion peak is observed in mass spectrum
[ ] Ionizing electrons are emitted from a heated tungsten filament
[ ] Used to obtain accurate molecular mass information about polar biopolymers ranging in molecular mass from a few thousand to several thousand Dalton

**Fill in the blank by most appropriate VALUE or WORD**

11. How many peaks are present in the NMR signal for the indicated proton in $CH_3CH_2OC\underline{H}_3$? _____

12. In Infra-red spectroscopy, the number of normal modes for $H_2O$ molecule is _____.

13. A chromatogram of a mixture of species A and B provided the following data: void time is 3.1min, retention time for A and B species is 15.8 min and 17.3 min respectively. The peak width for A and B are 1.13 and 1.22 min respectively. The retention factor for earlier eluting solute will be_____

14. After TLC development the solvent front has moved 8.0 cm, component 1 has moved 4.9 cm and component 2 has moved 3.5 cm from the original sample spot. The Rf value for each component is _____ and _____ respectively.

15. The _____ is an atomization technique mostly applicable for the determination of Mercury.

16. The energy (in Joule) of 600 nm photon is _____

17. In ion exchange chromatography the detector is based on _____ measurement.

18. One of the form of Van demeter equation is_____

19. HPLC separation where the composition of solvent is changed in step wise manner during the analysis (solvent programming) is called_____.

20. _____of an instrument is a measure of its ability to discriminate between small differences in analytical concentration.