

KATHMANDU UNIVERSITY

End Semester Examination[C]

June/July 2024

Level : B.E./B. Pharm./B.Tech.

Year : III

Time : 2 hrs. 30mins.

Course : INAN 301

Semester : I

F. M. : 55

10 JUL 2024

SECTION "B"

[5Q × 3 = 15 marks]

Attempt *ANY FIVE* questions

- 1 a. Show the basic design of an instrument used for a chemical measurement. [1.5+1.5]  
b. What are transfer function and dynamic range?
- 2 A method for the analysis of  $\text{Ca}^{2+}$  in water suffers from interference in the presence of  $\text{Zn}^{2+}$ . When the concentration of  $\text{Ca}^{2+}$  is 100 times greater than that of  $\text{Zn}^{2+}$  the analysis for  $\text{Ca}^{2+}$  gives a relative error of +0.5%. What is the selectivity coefficient for this method? [3]
- 3 Calculate the approximate wave number and wave length of the fundamental absorption due to the stretching vibration of a carbonyl group C=O. [3]
- 4 How do you relate absorbance with transmittance? What is Beer's law? [1.5+1.5]
- 5 What do you mean by spectral interference? When are releasing agents and protective agents used? [3]
- 6 A compound had a molar absorptivity of  $3.03 \times 10^3 \text{ L mol}^{-1} \text{ cm}^{-1}$ . What concentration of the compound would be required to produce a solution that has a transmittance of 9.53% in a 2.50 cm cell. [3]
- 7 Is  $\text{CO}_2$  molecule IR active? Justify. [3]

SECTION "C"

[5Q × 5 = 25 marks]

Attempt *ANY FIVE* questions.

- 8 Explain (with well labelled diagram) about the most common radiation source used for atomic absorption measurements. Write the principle of flame emission spectrometry. [3.5+1.5]
- 9 a. What are the different types of NMR spectra? [3]  
b. How can spin-spin splitting lines be differentiated from chemical shift lines? [2]
- 10 a. Explain about absorption by organic compounds in UV Visible region. [3]  
b. In NMR spectroscopy, what are the advantages of using a magnet having highest possible field strength? [2]
- 11 a. In chromatography, what are the variables that lead to zone broadening? [3]  
b. What are internal reference materials used in NMR? [2]

P.T.O.

- 12 a. How do gas phase and desorption sources differ? What are the advantages of each? [2.5]  
b. What do you know about ion chromatography based on suppressors? [2.5]
- 13 Write about size exclusion 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"  
[2Q × 7.5 = 15 marks]

Attempt *ANY TWO* questions.

- 15 a. Differentiate between normal phase and reversed phase chromatography. Also write about common visualization methods in Thin Layer Chromatography. [4]  
b. Write short note on columns used in GC. [3.5]
- 16 a. What are magnetic sector analyzers? Explain with diagram. [5]  
In what aspect double focusing instrument is different from single focusing instrument?  
b. Write short note on role of solvent in UV visible spectroscopy [2.5]
- 17 a. Differentiate:  
(i) Single beam instrument and double beam instrument (ii) Finger print and group frequency region [2+2]  
b. In NMR, what are the different factors that affect chemical shift value? [3.5]

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Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 10 JUL 2024

SECTION "A"

[20Q.  $\times$  1 = 20 marks]

**Encircle the most appropriate answer.**

- Which of these statements is **TRUE**?
  - Accuracy provides a measure of random error.
  - Conductometry and potentiometry are examples of classical analytical methods
  - Frequency is analog signal.
  - The characteristic property for Turbidimetry is scattering of radiation.
- Which of these statements is **NOT** true?
  - The input transducer for atomic emission spectrometer is photomultiplier tube
  - The information sorter for flame photometer is filter
  - Detector converts electrical signal to non-electrical signal and vice versa.
  - Sensors are the devices that are capable of monitoring specific chemical species continuously and reversibly
- In UV absorption spectroscopy, which of the following statements is **NOT** true?
  - $n \rightarrow \pi^*$  and  $\pi \rightarrow \pi^*$  transitions require the presence of an unsaturated group
  - A shift to longer wavelength lowers the energy.
  - Ultraviolet photons carry more energy than visible photons
  - $\sigma \rightarrow \sigma^*$  transitions are lower in energy than  $\pi \rightarrow \pi^*$  transitions
- 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
- In which region of the electromagnetic spectrum does absorption at  $5 \times 10^4 \text{ cm}^{-1}$  wave number lies?
  - Ultraviolet region
  - Visible region
  - Vacuum UV region
  - Infrared region
- Rank the following bonds in order of decreasing stretching frequency ( $\text{cm}^{-1}$ ) in IR spectrum.  
[A] O-H (alcohols) [B] C=O (ketones) [C] C-X (alkyl halide) [D] C-H (alkanes)
  - A < D < B < C
  - C < B < A < D
  - B < A < C < D
  - D < C < B < A
- How many peaks are present in the NMR signal for the indicated proton in  $\text{CH}_3\text{CH}_2\text{Br}$ ?
  - 3
  - 4
  - 9
  - 2

8. The spectroscopic technique used in MRI is
- Mass spectroscopy
  - NMR Spectroscopy
  - IR Spectroscopy
  - AAS
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 statements accurately describes the molecular vibration characteristics of IR spectroscopy?
- Stretching frequencies appear mostly in the finger print region
  - Triple bonds have lower stretching frequencies than double bonds
  - Bonds to the hydrogen have higher stretching frequencies than those to heavier atom
  - Stretching frequencies are lower than corresponding bending frequencies

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

11. A nucleus has a spin quantum number of  $9/2$ . How many magnetic energy states does this nucleus have? \_\_\_\_\_
12. In Infra-Red Spectroscopy, the number of vibrational 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. In mass spectrometry, the resolution needed to separate the ions  $M^+$  and  $N^+$  with masses 17.0313 and 17.0187, respectively is \_\_\_\_\_.
15. The \_\_\_\_\_ is an atomization technique mostly applicable for the determination of Mercury.
16. The energy (in Joule) of 530nm photon is \_\_\_\_\_
17. Among  $^1H$ ,  $^2H$ ,  $^{13}C$  and  $^{19}F$ , which nuclei does not show NMR signal? \_\_\_\_\_.
18. \_\_\_\_\_ detector which is used in GC employs a radioactive beta emitter, usually nickel-63.
19. HPLC separation where solvent composition remains same throughout analysis is called \_\_\_\_\_.
20. \_\_\_\_\_ is an example of anion exchange resin (strong).