KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E.
Year : III

Course : INAN 301
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

25 JUN 2023

Registration No.:

Date :

SECTION "A"
[20 Q. × 1 = 20 marks]

Mark [X] in the most appropriate option.

1. Which of the following transition is not possible in UV-vis absorption?
[ ] $\sigma \rightarrow \sigma^*$ [ ] $\sigma \rightarrow n$ [ ] $\sigma \rightarrow \pi^*$ [ ] $n \rightarrow \pi^*$

2. Which of the following is the **CORRECT** order in which light passes through a UV-V is spectrometer?
[ ] detector, sample, source, monochromator
[ ] source, monochromator, sample, detector
[ ] monochromator, source, sample, detector
[ ] sample, source, monochromator, detector

3. Which of the following are **NOT** IR sources?
[ ] The Nernst glower [ ] The Globar source
[ ] An incandescent wire [ ] A pyroelectric glower

4. Advantages of using a silver chloride cell rather than a sodium chloride sample cell in IR is
[ ] aqueous sample can be measured [ ] silver chloride does not absorb IR radiation
[ ] silver chloride is translucent [ ] silver chloride is less expensive

5. Hollow cathode lamp necessary in AAS because _____.
[ ] cathode lamps are cheaper to operate and maintain
[ ] continuous spectrum lamps do not emit at the proper intensity
[ ] the width of an atomic absorption band is narrow
[ ] continuous spectrum lamps cause ionization of the molecules

6. Which of the following quantities is not changed at a different magnetic field strength?
[ ] chemical shift (in hertz)
[ ] nuclear spin population in an energy state
[ ] coupling constant
[ ] energy difference between two energy states of nuclei with non zero spin quantum number

7. Chromatographic column with more theoretical plates _____.
[ ] makes separation impossible
[ ] take a long time to perform separation
[ ] are better suited to separate complex mixture
[ ] interact irreversibly with the analyte

8. Which of the following statement about the sensitivity of an analytical method is **TRUE**?
   [ ] sensitivity and detection limit of analytical instruments are same
   [ ] sensitivity of an analytical method is a measure of ability to determine whether slight differences in experimental results are significant
   [ ] sensitivity of an analytical method is the smallest amount of analyte that the instrument is able to measure
   [ ] sensitivity of analytical methods is response of the instrument to human error

9. Reverse phase chromatography refers to
   [ ] A stationary phase and mobile phase of similar polarity
   [ ] A non polar stationary phase and a non polar mobile phase
   [ ] A polar stationary phase and a non polar mobile phase
   [ ] A non polar stationary phase and polar mobile phase

10. When performing calculation for standard addition method, which of the following must be **TRUE**?
   [ ] volume of standard added must be added with the volume of the sample used
   [ ] volume of standard added is subtracted from the total volume of the sample used
   [ ] volume of standard added can be ignored, because volumes are not used in the calculation
   [ ] volume of standard added can be ignored, because it is part of the blank correction

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

11. The purpose of a monochromator is _____.

12. Chemical interference in AAS that cannot be accounted for using a background correction, but can be minimized by _____.

13. Separation of ions in mass spectrometer takes place on the basis of _____ _____.

14. Chemical ionization produced _____ charged ions in mass spectrometry.

15. Chemical shift originated from _____.

16. _____ ^{1}H signal and _____ ^{13}C signal appear for $(CH_3)_3CCH_2CHO$ in ^{1}H NMR and ^{13}C NMR

17. Ion exchange chromatography is known for the best separation of _____ _____.

18. Fronting in HPLC chromatogram is a result of _____ with sample.

19. Most common support materials for a packed GC column is _____ _____.

20. _____ is used for the detection of chlorinated compounds like pesticides using gas chromatography.

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

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

SECTION "B"
[5Q. × 3 = 15 marks]

Attempt *ANY FIVE* questions.

a. a. Explain with suitable example the role of detector and transducer in analytical instrument. [1.5]

b. What are the advantages of flame atomizer in AAS? [1.5]

2. a. Discuss the application of UV-Vis spectroscopy for analysis of organic molecules. [1.5]

b. Why are homonuclear diatomic molecules IR inactive? [1.5]

3. a. Carbon monoxide shows an absorption band at 2140 cm^{-1} . Calculate the force constant for the molecules. [2]

b. Why aromatic proton appears at higher δ value? [1]

4. a. Predict the appearance of high-resolution proton NMR of ethyl benzene and methyl ethyl ketone. [2]

b. What resolution is needed to separate the ions $C_2H_4^+$ and CH_2N^+? [1]

5. a. Anisotropic effects exist in 1H-NMR for alkenes and alkynes. Justify? [1.5]

b. Calculate the Larmor frequency for proton in 21.2 T magnetic field. [1.5]

6. a. Describe the various steps involved in thin layer chromatography. [2]

b. Why is ^{13}C-^{13}C splitting not observed in ordinary organic compounds. [1]

7. What is matrix effect? Explain the methods involved in minimizing such effect. [3]

SECTION "C"
[5Q. × 5 = 25 marks]

Attempt *ANY FIVE* questions.

8. a. Distinguish packed bed and open tubular column. [3]

b. Briefly explain the working principle of magnetic sector analyser. [2]

9. a. Explain with suitable example shielded and deshielded proton. [2]

b. Calculate the molar absorptivity of a solution prepared by dissolving 0.1298 gram of compound (MW = 214.3) in one liter of solution. The absorbance of solution at 255 nm is 0.824. [3]

10. a. Explain with suitable example different modes of vibration for a linear triatomic molecule. [2]

b. Why does a polar solvent shift n to π^* transition to a shorter wavelength and π *to* π^* to a longer wavelength? Explain giving suitable example. [3]

11. a. Explain with suitable example the effect of flame temperature on atomic spectra. [2.5]

b. Frequency of O-H stretching is absorbed at higher range than the C-H stretching. Give reasonable explanation. [2.5]

12. a. What is retention time? How chromatographic separation is optimized using selectivity factor. [0.5 + 2.0]

b. Distinguish between ion-exchange and size exclusion chromatography. [2.5]

13. a. Write short notes on the data domain of analytical instruments. Show how data are encoded in digital domain. [2.5]

b. Why sharp line source is required in AAS? Explain the working principle of hallow cathode lamp. [0.5 +2.0]

14. Write short notes on. [2.5 × 2 = 5]
a. Column resolution and column efficiency
b. Retention index

SECTION "D"

[2Q.× 7.5 = 15 marks]

Attempt *ANY TWO* questions

15. a. Discuss the working principle of PDA and IR detector in HPLC. Also, give any two examples of the molecules that can be analyzed using these detectors in HPLC. [4+1]

b. Explain the factor influencing band broadening in chromatographic elution. [2.5]

16. a. Explain the working principle of chemical ionization (CI) and Electron Impact (EI) methods used in mass spectrometry and its application. [5]

b. Describe the working principle of FID in GC and also shed light on its advantages and limitation. [2.5]

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17. IR, Mass and NMR spectra for the unknown compounds is given below. Based on these spectra identify the structure of the compounds. [7.5]