KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Mark Scored:

Level : B.Sc./B.Pharm./B.Tech.
Year : III
Course : INAN 301
Semester : I
Exam Roll No. :
Time: 30 mins.
F. M. : 20
Registration No.:
Date : 04 JUN 2019

SECTION "A"
[20 Q. × 1 = 20 marks]

Choose and mark [X] *at the most appropriate answer from the given choices.*

1. Which of the following statement accurately describes the molecular vibration characteristics of IR spectroscopy?
   [ ] stretching frequencies appear mostly in the fingerprint regions
   [ ] triple bonds have lower stretching frequencies than corresponding double bonds, which in turn have lower frequencies than single bonds
   [ ] bonds to the hydrogen have higher stretching frequencies than those to heavier atom
   [ ] stretching frequencies are lower than corresponding bending frequencies

2. The function of the chopper in atomic absorption spectroscopy is
   [ ] to split the beam into two
   [ ] to break the steady light into pulsating light
   [ ] to filter unwanted component
   [ ] to reduce the sample into atomic state

3. What is the order of the following carbonyl compounds in decreasing wavenumber in IR spectroscopy?
   (I) butanoyl chloride (II) ethyl butanoate (III) pentanol (IV) propanoic acid
   [ ] III, IV, II, I [ ] I, IV, II, III [ ] III, II, IV, I [ ] I, II, III, IV

4. Which compound has molecular ion at m/z = 58, an infrared absorption at 1650 cm^{-1} and just one singlet in 1H-NMR?
   [ ] $CH_3CH_2CH_2CH_3$
   [ ] CH_3COCH_3
   [ ] CH_3CH_2CHO
   [ ] $CH_3CH(CH_3)CH_3$

5. Which of the following options explains the process of "sputtering" that occurs in Hollow Cathode Lamp?
   [ ] positive ions collide with cathode surface and metal atoms from cathode are ejected
   [ ] negative ions collide with cathode surface and metal atoms from anode are ejected
   [ ] positive ions collide with negative ions and metal atoms from anode are ejected
   [ ] positive ions collide with negative ions and photons are ejected

6. In a quartet in 1H-NMR, the relative peak areas are in the ratio of
   [ ] 1:1:1:1 [ ] 1:2:2:1 [ ] 1:3:3:1 [ ] 1:4:4:1

7. In reverse phase HPLC, molecules with _____ polarities elute first, and molecules with _____ polarity elute last.
   [ ] lower, higher
   [ ] varies with solutes
   [ ] higher, lower
   [ ] higher, higher

8. In a gas chromatography, what is the main advantages of a FID over TCD?
[ ] it is more sensitive to most organic compounds
[ ] it is selective for compounds with electronegative groups
[ ] it is less sensitive to gradients elution
[ ] it is not destructive

9. The elution order for the following solutes in a liquid chromatography system consisting of a toluene mobile phase and a silica stationary phase would be
[ ] benzene, tetrahydrofuran, methanol
[ ] methanol, benzene, tetrahydrofuran
[ ] tetrahydrofuran, methanol, benzene
[ ] methanol, tetrahydrofuran, benzene

10. Which of the following is false statement about wavelength of electromagnetic radiations?
[ ] radiation with short wavelength have higher energy
[ ] energy does not depend on wavelength
[ ] radiation with long wavelength have low energy
[ ] energy depends on wavelength

Fill in the blanks with appropriate WORDS or VALUE.

11. Data represented by binary coding on a single transmission lines are called _____

12. _____of an instrument is a measure of its ability to discriminate between small difference in analyte concentration.

13. The molar absorptivities for n – π^* transitions are normally low and usually range from _____ _____

14. The ultraviolet spectra of aromatic hydrocarbon are characterized by three sets of bands that originate from _____ transition.

15. Separation of ions in mass spectrometer take place on the basis of _____

16. Proton NMR spectrum of propane will consist of _____

17. Doubling the column's length increases resolution by a factor of _____

18. In a HPLC, a RI detector is a _____detector and is limited to _____elution.

19. Split injections are required in GC capillary column because _____

20. _____ are most commonly used fuels in flame photometry.

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Year : III
Time : 2 hrs.30 mins.

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

SECTION "B"
[5Q. × 3 = 15 marks]

Attempt *ANY FIVE* questions.

1.
   a. How do you measure the dynamic range of an analytical instruments? [1.5]
   b. A solution of thickness 2 cm transmits 40 % incident light. Calculate the concentration of solution, given that $\varepsilon = 6000$ L mol^{-1} cm^{-1} [1.5]

2.
   a. State the working principle of flame photometry. Give any two examples of metal ions analysis using flame photometry. [2]
   b. A molecule like HCl can undergo stretching vibration only, while a molecule like CO_2 can undergo stretching as well as bending vibration. Explain. [1]

3.
   a. Briefly explain the types of fuels and oxidant used in AAS. [2]
   b. Calculate the resolution required to resolve the peaks for $C_3H_5N_3^+$ (M = 85.0641) and $C_3H_9O^+$ (M = 85.0653). [1]

4.
   a. Why do capillary column predominant in analytical GC? [1]
   b. Define coupling constant. What is the Larmor frequency for proton in magnetic field of 1.5 T and 3.0 T. [1+1]

5.
   a. List out four output transducers and describe how they ae used. [1.5]
   b. What are chromophores? Explain with suitable example. [1.5]

6.
   a. Describes the methods for determining number of plates in a column. [1.5]
   b. What is pulsed flow in HPLC, why does it occur, and why is this not a desirable feature? [1.5]

7.
   a. What variables are likely to affect selectivity factor α for a pair of analytes? [1.5]
   b. Calculate the force constant of the HCl bond if the molecules absorb at 3343.8 nm. [1.5]

SECTION "C"

[5Q. × 5 = 25 marks]

Attempt *ANY FIVE* questions.

8.

a. Describe how the "C_u" term of the Van Deemeter equation contribute to band broadening. Why is it directly proportional to mobile phase flow rate? [3]

b. Why does double focusing mass spectrometer give narrower peaks and higher resolution than single focusing instrument? [2]

9.

a. Describe the instrumentation, principle and working of atomic absorption spectroscopy. [3]

b. Differentiate between gradient and isocratic elution. What advantages does gradient elution have over isocratic separation? [2]

10.

a. Explain with suitable examples the spectral and chemical interference in AAS. [3]

b. $\pi - \pi^*$ transition is the most common and useful transition in UV-Vis spectroscopy. Explain with suitable examples. [2]

11.

a. Briefly explain the types of light sources used in the ultraviolet –visible region in UV-Vis spectrophotometer. [3]

b. Explain shielded and deshielded proton with suitable examples. [2]

12.

a. Explain the Beer's law and its limitation in quantitative estimation. [3.5]

b. What do you mean by destructive interference in IR? [1.5]

13.

a. How do you measure the performance characteristics of the column in chromatography? [2]

b. What is an FID and how does it work? What types of analytes does FID respond to? [3]

14.

a. Differentiate between Nernst glower and Glower source of radiation in IR. [3]

b. What is the Larmor frequency? Why is it necessary to use deuterated solvents for NMR experiments? [2]

SECTION "D"

[2Q. × 7.5 = 15 marks]

Attempt *ANY TWO* questions.

15.

a. How does a mass spectrometer work? Explain in details the ion sources used in mass spectrometry. [0.5 + 5]

b. Define chemical shift. Why is ^{13}C-^{13}C spin-spin splitting not observed in ordinary organic compounds? [1+1]

0 4 JUN 2019

16. Write short notes on [3 × 2.5 =7.5]
    i. Standard addition method
    ii. Ion exchange chromatography
    iii. TCD and ECD detector

17. The IR, MS, ^{1}H- NMR and ^{13}C-NMR spectra of the unknown compounds is given below. Identify the structure. [7.5]