Roll No. .....

E–518

M. Sc. (Second Semester) (Main/ATKT)

EXAMINATION, May-June, 2021

CHEMISTRY

Paper Fourth (CH–10)

(Theory and Application of Spectroscopy–II)

Time : Three Hours] [*Maximum Marks : 80*

[*Minimum Pass Marks : 16*

Note : Attempt all Sections as directed.

Section—A 1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. The Beer-Lambert's law gives a linear correlation with positive gradient between :
   (a) Molar extinction coefficient and concentration
   (b) Molar extinction coefficient and absorbance
   (c) Wavelength and absorbance
   (d) Absorbance and concentration

2. What is a red shift ?
   (a) The shifting of an absorption band to shorter wavelength of the spectrum
   (b) The shifting of absorption band towards the longer wavelength of the spectrum
   (c) The shifting of absorption band to higher energy
   (d) The shifting of absorption peak to higher energy

3. Which of the following electronic transitions is not possible in the UV-Vis region ?
   (a) $n \rightarrow \sigma^*$
   (b) $n \rightarrow \pi^*$
   (c) $\pi \rightarrow \pi^*$
   (d) $\sigma \rightarrow \sigma^*$

4. Which of the methods is used to determine the stoichioinetry of the complexes where the total concentration of metal and ligand are kept constant but their ratio vary for measurement of absorption of solution in UV-Vis ?
   (a) Slope Ratio method
   (b) Mole-Ratio method
   (c) Job's method
   (d) Stability constant method

5. Phenol shows the primary absorption band at 230 nm. If the concentration of phenol in water is 1×10^{-4} M showing the absorbance value of 1.30 at 230 nm in UV-Vis spectrophotometry, calculate the molar absorptivity of this absorption band :

   (a) 2.3×10^4

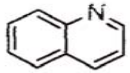
   (b) 3.3×10^4

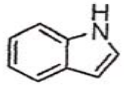
   (c) 1.3×10^4

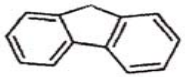
   (d) 4.3×10^4

6. Which of the following molecule shows the highest fluorescence intensity ?

   (a) 

   (b) 

   (c) 

   (d) 

7. The presence of oxygen in the sample solution could cause one of the following processes :

   (a) External conversion

   (b) Intersystem crossing

   (c) Internal conversion

   (d) Vibrational relaxation

8. The morphology of sample surface can be determined by measurement of the following in SEM technique is :

   (a) Secondary electron

   (b) Secondary ions

   (c) Emitted X-ray

   (d) Back scattered electron

9. Electron diffraction technique is good for analysis of :

   (a) Oxidation state

   (b) Morphology

   (c) Crystalline structure

   (d) Topography

10. Turbidimtery is preferred for the measurement for :

    (a) high concentrated sample

    (b) low concentrated sample

    (c) medium concentrated sample

    (d) Both (a) and (b)

11. Which of the following ions first reaches the detector in TOF ?

    (a) $CH_3CH_2CH_2CH_2^+$

    (b) $CH_3CH_2CH_2^+$

    (c) $CH_3CH_2^+$

    (d) CH_3^+

12. In which technique the methane gas is used for ionization of molecules in MS ?

    (a) EI

    (b) CI

    (c) FAB

    (d) MALDI-MS

13. Which of the following is not a use for mass spectrometry ?

    (a) Calculating the isotopic abundance in elements

    (b) Investigating the elemental composition of plants

    (c) Confirming the presence of O–H and C = O in organic compounds

    (d) Calculating the molecular mass of organic compounds

14. GC-MS has been developed for which of the following systems ?

    (a) Packed column

    (b) Closed tubular column

    (c) Open tubular column

    (d) Porous layer

15. Which of the following is most hard ionization technique in MS ?

    (a) ESI

    (b) EI

    (c) MALDI

    (d) FAB

16. The molecule $HOCH_2CH_2OH$ will have an NMR spectrum consisting of :

    (a) two singlets

    (b) a triplet and a doublet

    (c) two doublets

    (d) a singlet and a doublet

17. Using a 60 MHz instrument, the difference in frequency between TMS absorption and a certain proton in a compound was found to be 120 MHz. What is the chemical shift value for this absorption in parts per million ?

    (a) 3

    (b) 2

    (c) 1

    (d) 0.5

18. When an external magnetic field is applied, what happens to the protons in a sample ?

    (a) All protons align with the field

    (b) All protons align opposite to the field

    (c) Some protons align with the field and some align opposite to the field

    (d) All protons assume a random orientation

19. The fine structure of the CH_2 group in diethyl ether consist of lines with an intensity distribution (given by Pascal's triangle) :

    (a) 1 : 3 : 3 : 1

    (b) 1 : 2 : 1

    (c) 1 : 1

    (d) 1 : 4 : 6 : 4 : 1

20. Which of the following molecules will show highest chemical shift (δ) ?

    (a) $CH_3–CH_2–CH_3$

    (b) $CH_2 = CH–CH_3$

    (c) $CH \equiv CH–CH_3$

    (d) CH_3CH_3

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions in 2-3 sentences.

1. Define Franck-Condon's principle.
2. What is mole-ratio method for determination of ligand/metal ratio ?
3. Write the principle of electron diffraction technique.
4. What is the reason for obtaining the relaxation vibration phenomenon in fluorescence process ?
5. State the nitrogen rule and write its significance.

6. Sketch the fragmentation pattern of $CH_3CH_2CH_2CH_3$ in EI.
7. Why TMS is used as a standard in nuclear magnatic resonance spectoscopy ?
8. Write the application of NMR for estimation of hydrogen bonding.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions. Write answer in < 75 words.

1. Give the name of chromophoric reagent and chemical reaction for determination of Fe(III) from drinking water using UV-Vis spectrophotornetry.
2. What is rotational fine structure of electronic-vibrational spectra ?
3. Write the difference between Nephelometry and Turbidimetry.
4. How does the temperature and pH of sample solution affect the fluorescence phenomenon ?
5. How many fragmentation of molecule (CH_3 $(CH_2)_3CH_2OH$) mass spectrometer ?
6. What is the working principle of Quadrupole analyzer ?
7. Show how you would distinguish between propanol and acetone using NMR spectroscopy. Label the axes and schematically shows all the important features in the spectrum.

8. What do you mean by spin-spin splitting and spin coupling in NMR ?

Section—D 5 each

(Long Answer Type Questions)

Note : Attempt all questions. Write answer in < 150 words.

1. Describe the vibrational-electronic spectra of diatomic molecules.

Or

Discuss any *one* of the method with example to determine the stoichiometric ratio of ligand to metal ratio in any metal complexes.

2. Shortly explain the principle and instrumentation of Nephelometry for analysis chemical of substances.

Or

Write the principle of Scanning Electron Microscope (SEM). What are the different applications of SEM ?

3. Explain the guidelines to determine the molecular formula in mass spectrum.

Or

Shortly explain the different types of mass analyzer for separation of compound mixture in MS.

4. How does the inductive, anisotropic and hybridization of molecule affect the chemical shift in NMR ?

Or

Write short notes on the following :

(a) Carbon-13 NMR spectroscopy

(b) Theory and application of NMR