

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the academic year 2008-09)

SUBJECT CODE: CH/MC/SP64

B.Sc. DEGREE EXAMINATION, APRIL 2011
BRANCH IV - CHEMISTRY
SIXTH SEMESTER

Reg. No

COURSE : MAJOR – CORE
PAPER : SPECTROSCOPY
TIME : 30 MINUTES

MAX. MARKS : 30

SECTION – A
TO BE ANSWERED ON THE QUESTION PAPER ITSELF.

ANSWER ALL THE QUESTIONS.

(30x1=30)

I Choose the correct answer:

- Hydrogen bonding in molecules shifts the UV absorption to _____ wavelength.
a) shorter b) longer c) no effect d) none
- The decrease in polarity of the solvent will have _____ shift in the $n \rightarrow \pi^*$ transition.
a) blue shift b) red shift c) hyperchromic d) hypsochromic
- The position of IR absorption of a particular bond in a substance will be higher at _____ state.
a) liquid b) gaseous c) solid d) none of the above
- Which of the following molecules will absorb in the IR region?
a) HCl b) Cl₂ c) H₂ d) N₂
- The scattered light that has lower frequency than the incident is called _____.
a) stoke's line b) antistoke's line c) Rayleigh line d) none
- The number of different types of protons that are present in allyl bromide is _____.
a) 2 b) 3 c) 4 d) 5
- Which among the following can be used as a solvent in NMR spectral analysis?
a) CCl₄ b) CS₂ c) CDCl₃ d) all the above
- Which of the following nuclei will cause absorption in the NMR spectroscopy?
a) C¹² b) O¹⁶ c) H¹ d) H²
- In the mass spectrum of toluene the peak observed with 100 % intensity is at m/e = _____.
a) 91 b) 44 c) 100 d) 60
- The most intense peak in mass spectrum is called _____.
a) base peak b) meta stable peak c) parent ion peak d) isotope peak

II Fill in the blanks:

11. The radiation source used in UV-Vis spectrometer _____.
12. The absorption maximum of aniline in acidic medium is _____ than in neutral solution.
13. The theoretical number of possible fundamental band for the linear molecules is _____.
14. The intensity ratio of splitting signals in NMR spectrum is based on _____.
15. In the case of chloro compounds, M^+ and $[M^+2]$ peaks are formed with the intensity ratio _____.

III Specify the following as TRUE or FALSE:

16. All auxochrome contain non-bonding pairs of electrons.
17. The λ as well as ϵ increases with increase in conjugation.
18. Methanol is good solvent for UV-Visible but not for IR spectral analysis.
19. Aldehyde proton appears much upfield in the PMR spectrum.
20. Relatively much intense molecular ion peak in aromatic system is due to the π -electron system.

IV Answer the following in one or two lines:

21. A 2.5×10^{-4} M solution of a substance in a 1 cm length cell at $\lambda_{\max} = 245$ nm, has the absorbance 1.17. Calculate the ϵ_{\max} for this transition.

22. Which of the following compounds would be suitable as a solvent for use in recording UV spectra of organic compound? Why?
Cyclohexane & benzene

23. Why are electronic absorption observed as bands instead of peaks?

24. How will you differentiate *o*-hydroxy benzoic acid and *m*-hydroxy benzoic acid by IR spectral analysis?
25. Arrange the following in their increasing order of $\nu(\text{C-H})$ value.
Ethane, ethene, ethyne
26. Why is the molecular ion peak of aromatic compounds strong?
27. How many spin state are possible for ^1H nucleus?
28. What is meant by induced magnetic field?
29. What is chemical shift?
30. Define Nitrogen rule.

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MAX. MARKS : 70

SECTION – B

ANSWER ANY FIVE QUESTIONS:

5X6=30

1. a) What are absorption laws? How is an UV spectrum plotted? (4)
b) Calculate the energy associated with a radiation having wavelength 4000 Å. (2)
2. Explain the various types of electronic transitions with example.
3. Explain the following
(i) chromophore (ii) auxochrome (3+3)
4. Arrange the following in their decreasing order of $\nu(\text{C}=\text{O})$ value and justify your answer.
HCHO, CH₃CHO, CH₃COCH₃
5. Discuss the Frank-Condon Principle.
6. What are the reference compounds used in NMR spectral analysis and mention their characteristics?
7. Explain the fragmentation pattern of the following compounds. (4+2)
(i) n-butanol (ii) phenol

SECTION – C

ANSWER ANY TWO QUESTIONS:

2X20=40

8. a) Explain the instrumentation of UV-Visible spectrometer using a block diagram. (7)
b) What are the various types of absorption and intensity shifts in electronic transition of aromatic compounds. (5)
c) Calculate the absorption maxima for the following compounds. (4+4)
(i) (ii)

9. a) Differentiate IR and Raman spectroscopy. (6)
b) Discuss the sampling technique used in IR spectrometry. (8)
c) Write the expected IR band values for the following compounds. (3+3)
(i) acetone (ii) salicylaldehyde
10. a) Explain the factors which affect the chemical shift. (6)
b) Explain the following. (4+4)
(i) spin-spin splitting (ii) Pascal's triangle
c) A compound with the molecular formula C_8H_8O gives the following PMR spectral data: $\delta(\text{ppm})$: 9.78 (t, 1H), 7.28 (m, 5H), 2.8 (d, 2H). Give the structure. (6)
11. a) Discuss about the instrumentation of mass spectrometer. (8)
b) Explain the following with example. (3+4)
(i) metastable peak (ii) McLafferty rearrangement
c) Determine the structure of compound whose m/e values are $m/e = 74$ (molecular ion), 56, 43, and 31 (base peak). (5)

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