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DEPARTMENT OF CHEMICAL SCIENCES
B.Sc/ B.Ed DEGREE RAIN SEMESTER EXAMINATION 2016/2017
CHM 312: APPLIED SPECTROSCOPY (2 UNITS) BIOCHEMISTRY
JUNE, 2017 TIME: 1½H

INSTRUCTION: ANSWER ALL QUESTIONS

1. Mention any two (2) factors that can affect the intensity of an IR absorption band. 2 mks
2. Mention any two (2) factors that can affect the position of an IR absorption band. 2 mks
3. How would you differentiate between the IR spectrum of $CH_3CH_2CH_2CH_2OH$ and $CH_3CH_2OCH_2CH_3$? 2mks
4. How would you differentiate between the IR spectrum of $C_{H3}C_{H2}COOH$ and $C_{H3}C_{H2}COOC_{H3}$? 4 mks
5. How is the IR spectrum of a solid sample got? 2 mks
6. Explain why the O-H stretching vibration in a concentrated solution occurs at a lower wavenumber compared to that of a dilute solution. 2 mks
7. How would you know if a compound has CH_3 group in the IR absorption spectrum? 2 mks
8. Using the shape of the absorption band, how will you determine that an absorption band occurring at around 3300 cm^{-1} is from an N-H or an O-H? 2 mks
9. The C-H stretching vibration of an alkene depends on: 2 mks
10. The energy difference ΔE between the α- and β- spin states depends on 2 mks
11. 'Flipping' occurs when.....2 mks
12. Calculate the required operating frequency in MHz for a ^1H NMR spectrometer whose B_o =3.523 T, γ=2.675x $10^8 T^{-1} s^{-1}$ and π=3.1416 (3mks)
13. How many ^1H NMR signals does this $(CH_3)_2CCHBr$ compound have?....Which set of protons will have the highest chemical shift value and why ? 3 mks
14. The protons in these compounds: i. $(CH3)_2C_{H2}$ ii. $C_{H3}C_{H2}CHC_{H2}$ and iii. C_{2H2} have different chemical shift values. Which protons have the higher value? Give reasons for this observation.4 mks
15. Calculate the multiplicity for each proton set in $CH_3CH_2CH_2COOCH(CH3)_2$ 6 mks.
16. Explain the term 'coupling constant' and mention one (1) use of it. 3 mks
17. Mention one disadvantage of ^{13}C NMR spectroscopy. 2 mks
18. Why are the signals in a ^{13}C NMR spectrum all singlets? 2 mks
19. Draw the structure of 1-chlorobenzene and label all the carbon atoms. How many ^{13}C NMR signals do you expect to see for the compound? 4 mks
20. Mention ant two (2) uses of UV/Vis spectroscopy. 2 mks
21. Show diagrammatically and explain how conjugation is related to the energy required for electronic transition between the HOMO and the LUMO? 5 mks
22. How would you determine if a mass spectrum belongs to an alkyl chloride or an alkyl bromide? 4 mks
23. The mass spectra for pentane and 2-methylbutane are very similar, however there is an exception due to the peak at m/z=57. Explain. 2 mks
24. Why do we usually have small molecular ion peaks for alcohols? 2 mks
25. Mention any two (2) uses of mass spectrometry.2 mks
26. Explain why ketones usually have intense molecular ion peaks. 2 mks.