

TIME: 1 1/2 H

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 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$? 2 mks
4. How would you differentiate between the IR spectrum of $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$ and $\text{C}_6\text{H}_5\text{CH}_2\text{COOCH}_3$? 2 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 $B_0 = 3.523 \text{ T}$, $\gamma = 2.675 \times 10^8 \text{ T}^{-1} \text{ s}^{-1}$ and $\pi = 3.1416$ (3 mks)
13. How many ^1H NMR signals does this $(\text{CH}_3)_2\text{CCHBr}$ compound have?....Which set of protons will have the highest chemical shift value and why? 3 mks

14. The protons in these compounds: i. $(\text{CH}_3)_2\text{CH}_2$ ii. $\text{CH}_3\text{CH}_2\text{CHCH}_3$ and iii. C_2H_2 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 $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}(\text{CH}_3)_2$ 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 any 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

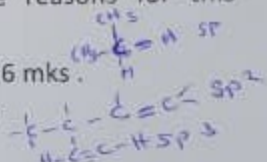
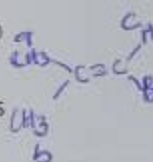
26. Explain why ketones usually have intense molecular ion peaks. 2 mks

Shape dipole moment C 2

Carboxylic acid

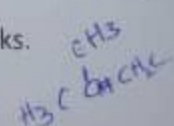
ester

3600-3200



Δε

56



12/9/9