

Duration: 3 hours

Total Marks: 75

- N.B.:** 1. All questions are compulsory  
 2. Figures to right indicate full marks  
 3. Draw structures wherever required.

Q. I Attempt all multiple-choice questions (MCQ)

20Marks

Sr. No.	Questions	Options
1	A C18 HPLC column can be used in	a Ion exchange chromatography
		b Size exclusion chromatography
		c Affinity chromatography
		d Ion pair chromatography
2	The chromatographic method of separating biochemical mixtures of compounds based on highly specific analyte - ligand interactions is referred to as _____	a Ion-pair chromatography
		b Ion-exchange chromatography
		c Gel permeation chromatography
		d Affinity chromatography
3	In SFC, what is the role of a co-solvent?	a It alters the polarity of the fluid
		b It increases the viscosity of the mobile phase.
		c It decreases the pressure required for the supercritical fluid.
		d It reduces the temperature required for the supercritical fluid.
4	Which ion source is expected to produce most fragmentation from the list given below?	a Fast atom bombardment
		b Matrix assisted laser desorption ionization
		c Electrospray ionization
		d Electron impact ionization

5	Protons belonging to which of the following groups will give the highest $\delta$ value in NMR spectrum?	a	-OH
		b	-NH <sub>2</sub>
		c	Aromatic
		d	Aldehyde
6	Which of the following method is online solvent degassing method in HPLC?	a	Vacuum filtration
		b	Continuous helium purging
		c	Ultrasonication
		d	Thermal programming
7	Pirkle columns are used for _____	a	Size exclusion chromatography
		b	Ion exchange chromatography
		c	Chiral chromatography
		d	Ion pair chromatography
8	In capillary electrophoresis, _____ is a plot of the time on the X-axis Vs the detector signal on the Y-axis	a	Chromatogram
		b	Spectrum
		c	Electropherogram
		d	Polarogram
9	A field free tube forms a part of which mass analyzer	a	Time of flight analyzer
		b	Magnetic sector analyzer
		c	Quadrupole analyzer
		d	Ion trap
10	The chemical shift of the protons in acetone is $\delta$ 2.06. How many hertz downfield from TMS will the resonance appear in a spectrum taken on a spectrometer operating at 300 MHz?	a	312 Hz
		b	618 Hz
		c	6180 Hz
		d	$6.18 \times 10^8$ Hz

11	Which of the following can cause fronting of peaks in HPLC	a	Incorrect detection wavelength
		b	Leaks in the HPLC system
		c	Very high flow rate
		d	Sample overload
12	The mobile phase in Gas chromatography is usually	a	Carbon dioxide
		b	Carbon disulfide
		c	Nitrous oxide
		d	Nitrogen
13	Which of the following is commonly used as mobile phase in SFC in its super-critical fluid state?	a	Oxygen
		b	Nitrogen
		c	Carbon dioxide
		d	Water
14	Which is the commonly used reagent for chemical ionization in mass spectrometry?	a	Argon
		b	Nitrogen
		c	Methane
		d	Oxygen
15	Which one of the following molecules will give only 2 signals in NMR spectrum	a	$\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
		b	$\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3$
		c	$\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_3$
		d	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
16	What is the nature of the mobile phase in reverse phase chromatography?	a	Polar
		b	Non-polar
		c	Hydrophobic
		d	Neutral

17	Affinity chromatography separation is based on	a	Charge on the analyte
		b	Specific interaction between analyte and ligand
		c	Partitioning
		d	Molecular size
18	What type of stationary phases are commonly used in SFC?	a	Normal-phase
		b	Ion-exchange
		c	Reverse-phase
		d	Size-exclusion
19	DART stands for	a	Direct Analysis in Real Time
		b	Dynamic Analysis in Real Time
		c	Dynamic Analysis of Rapid Transformations
		d	Distinctive Analysis of Reactive Toxins
20	In NMR spectroscopy, the value of which variable is not affected by applied magnetic field strength	a	Coupling constant
		b	Precessional frequency
		c	Proportion of excited to unexcited nuclei
		d	Energy gap between spin states of the nuclei

**Q. II Attempt any TWO questions****20 M**

1. a A chromatogram shows an unretained solute eluting out at a dead time of 1.2 minutes. There are two more peaks observed. Peak A starts at 3.3 minutes and ends at 3.7 minutes while peak B starts at 3.9 minutes and ends at 4.5 minutes. Assuming that peaks A and B are symmetric, calculate  
Adjusted retention time for peak A  
Capacity factor for peak B  
Selectivity factor  
Number of plates for peak B  
Resolution between peaks A and B **5 Marks**
1. b What is tandem mass spectrometry? What is its advantage? Write a note on any one type of tandem mass spectrometry. **5 Marks**
2. a What is the principle of Ion-exchange chromatography? Discuss the factors affecting retention and separation in ion exchange chromatography. **5 Marks**
2. b Discuss any one 2D NMR technique. **5 Marks**
3. a Draw labeled schematic diagram for Super critical chromatography instrument. Write four points of comparison of Supercritical chromatography with GC and HPLC. **5 Marks**
3. b What do you understand by Head space analysis? Enlist GC detectors and describe any one GC detector. **5 Marks**

**Q. III Attempt any SEVEN questions****35M**

1. Draw a neat labelled diagram of HPLC instrument and enlist the various types of pumps and detectors used in HPLC. Give two important point of difference between HPLC and UPLC. **5 Marks**
2. Discuss instrumentation of HPTLC **5 Marks**
3. Give principle of Capillary Electrophoresis. Write a note on CE-MS hyphenation. **5 Marks**
4. With the help of a diagram describe electrospray ionization in Mass spectrometry. **5 Marks**
5. Predict the structure of the compound  $C_4H_6O_2$  whose spectral data are as follows **5 Marks**  
IR (cm<sup>-1</sup>): 3500, 3050, 2960, 1720, 1620  
1H NMR ( $\delta$  ppm):  
1.9 (s) (3H)  
5.62 (d) (1H) (J = 3 Hz)  
6.22 (d) (1H) (J = 3 Hz)  
12.5 (s) (1H)  
Justify your answer

6. Write a note on MALDI and FAB in mass spectrometry. 5 Marks
  7. What do you understand by the term gradient elution. When should we use it? Discuss steps to troubleshoot problems related to peak shape during HPLC analysis. 5 Marks
  8. Give three points of difference between proton magnetic resonance and C13 NMR spectroscopy. Explain what is double resonance and its use. 5 Marks
  9. Write a note on chiral chromatography columns. 5 Marks
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