1. **Thin layer chromatography is an example of**
   (a) Partition chromatography
   (b) Electrical mobility of ionic species
   (c) Adsorption chromatography
   (d) None of the above

2. **In Gas chromatography, the basis for separation of the components of the volatile material is**
   (a) The difference in partition coefficient
   (b) Difference in conductivity
   (c) Differences in molecular weight
   (d) Differences in molarity

3. **In reverse phase chromatography, the stationary phase is**
   (a) Non-polar
   (b) Polar
   (c) Either polar or non-polar
   (d) None of these

4. **Sodium dodecyl Sulphate (SDS) used in electrophoresis is**
   (a) An anionic detergent
   (b) A cationic detergent
   (c) A non-ionic detergent
   (d) None of the above

5. **In native PAGE the separation of proteins is influenced by**
   (a) Charge
   (b) Size
   (c) Isoelectric point
   (d) Both a and b

6. **The advantage of using a discontinuous electrophoresis is**
   (a) Conformation of protein is conserved
   (b) Constantly maintain the charge of protein
   (c) Assist in migration of protein
   (d) Enhance resolution of separation

7. **Which of the following technique is suitable for the separation of large DNA fragments?**
   (a) AGE
   (b) PAGE
   (c) PFGE
   (d) None of the above

8. **The role of Ammonium Per Sulphate (APS) in SDS PAGE is to**
   (a) Act as a catalyst in the polymerization of acrylamide
   (b) Act as a source of free radicals
   (c) Act as a bridge between acrylamide and bis-acrylamide
   (d) Act as a pore builder in the polymerized gel

9. **Glycerol is added to the protein samples before they are loaded to the well. The function of Glycerol is to**
   (a) Stabilize protein structure
   (b) Provide density to the sample
   (c) Helps to bind SDS to the protein
   (d) Helps to cleave disulfide bond by 2-marcaptoethanol

10. **Which of the following will travel faster through the gel if the amount of DNA present is same in all the wells?**
    (a) Nicked
    (b) Closed circular
    (c) Supercoiled
    (d) Supercoiled and circular will migrate at same speed and faster than the nicked

11. **NMR is based on**
    (a) Charge of nucleus
    (b) Nuclear fission
    (c) Electrical moment of the nucleus
    (d) Magnetic moment of the nucleus

12. **A mixture of proteins (M,N,O,P)elute from gel filtration column in the order M, N, O, P. The protein that will form band at the top of an SDS-PAGE will be**
    (a) M (b) N
    (c) O (d) P

13. **A mixture containing 2 proteins having the same molecular mass. But they are different in their oligomeric properties. Which of the following technique will be useful to separate the two proteins?**
    (a) SDS-PAGE
    (b) Native PAGE
    (c) Isoelectric focusing
    (d) Both b and c

14. Electrophoretic separation of RNA molecules are done on the basis of their molecular weight. A denaturant like formaldehyde is often present in the gel system. The reason behind this is

(a) RNAs are usually small
(b) RNAs are sensitive to nucleases
(c) RNAs are single stranded and can form secondary structures by intrastrand base pairing
(d) RNAs are usually present in high amounts

15. Fluroscence recovery after photobleaching in live cells is used to determine

(a) Flip-flop movement of membrane lipids
(b) Lateral movement of transmembrane proteins
(c) Movement of peripheral proteins
(d) Co-localization of proteins

16. Fluorescence involves the excitation and emission of light based on the theory that

(a) The emission and excitation wavelength are same
(b) The emission wavelength is shorter than the excitation wavelength
(c) The emission wavelength is longer than the excitation wavelength
(d) None of the above

17. FRET stands for

(a) Fluroscence recovery energy transfer
(b) Fluroscence resonance energy transfer
(c) Fluroscence resonance electron transfer
(d) Fluroscence recovery electron transfer

18. Three proteins are moving together as a single band in a SDS-PAGE after loading in a single lane. Which of the following technique can be used to identify them?

(a) Mass spectroscopy
(b) NMR
(c) Native PAGE
(d) Western blot

19. A protein undergoes a post-translational modification. In order to identify the nature of modification some experiments were performed and the results are as follows:

1. Protein moved slowly in SDS-PAGE
2. Isoelectric focusing (IEF) shows that there was no change in pI
3. Mass spectrometric analysis showed that the modification was on serine

Based on these observations, it is more likely that the modification was a

(a) Phosphorylation
(b) Glycosylation
(c) ADP-ribosylation
(d) Ubiquitination

20. An α-helical conformation of a globular protein is best determined by

(a) X-ray crystallography
(b) Electron microscopy
(c) Circular dichorism
(d) None of the above

21. X-ray crystallography is

P. based on the scattering of X-ray
Q. non-destructive analytical technique
R. used in determining the arrangement of atoms within a crystal
S. based on Braggs law

(a) a. P and Q
(b) b. P, Q and S
(c) c. R and S
(d) d. P, Q, R and S

22. In liquid-gas chromatography, the stationary phase is

(a) Liquid
(b) Gas
(c) Solid
(d) Liquid coated on a solid surface

23. HPLC cannot be used to

(a) Determine the caffeine content in coffee samples
(b) Separate the organic pestisides
(c) Determine the mercury content in a fish sample
(d) Identify various pigments from a leaf sample

24. Two compounds are separated on a reverse phase paper chromatography. One has a R_f value 9 and the other one having a R_f value 6. Which of them is more polar?

(a) Compound with R_f value 9
(b) Compound with R_f value 6
(c) Both are equally polar
(d) Both are nonpolar

25. Supposed you have determined your partially purified protein is stable and active between pH 6 to 8.5. On either side of this range the protein is no longer functional. If you want to do ion-exchange using DEAE-Sepharose, which of the pH you want to maintain so that the protein of interest elute efficiently from the column?

(a) pH 5
(b) pH 6
(c) pH 7.5
(d) pH 8

26. Which of the following gel percentage is suitable for electrophoresis of a protein of molecular weight 30kDa?

(a) 5-10%
(b) 10-14%
(c) 20-25%
(d) None of the above

27. **The function of the stacking gel is to**
    (a) Ensure protein separation
    (b) Concentrate proteins in a small zone before they enter the resolving gel
    (c) Maintain pH
    (d) None of the above

28. **Pulsed-field gel electrophoresis is based on the principle that**
    (a) Change in the electric field orientation resolves large DNA fragment
    (b) Increasing the electric flow increases separation
    (c) Electric field applied for a longer time will increase separation
    (d) None of the above

29. **X-ray diffraction is a technique to analyze**
    (a) Powder
    (b) Liquid
    (c) Solid crystals
    (d) Gases

30. **How many picks will CH_3CH_2CHO have in ^1H NMR?**
    (a) 2
    (b) 3
    (c) 4
    (d) 6

31. **Which of the following statements about ionization in a mass spectrometer is not correct?**
    (a) Atoms are ionized to increase their acceleration
    (b) Atoms are ionized so they can be deflected
    (c) Gaseous atoms are ionized by bombarding them with high energy electrons
    (d) It doesn't matter how much energy you used to ionized the atoms

32. **The tertiary structure of a protein can be detected by**
    (a) X-ray crystallography
    (b) Spectrophotometry
    (c) Electrophoresis
    (d) Chromatography

33. **TEMED is used during SDS-PAGE. Its role is to**
    (a) Crosslinking the acrylamide and bis-acrylamide
    (b) Increases the pore size
    (c) Reduces the pore size
    (d) Catalyzes the polymerization reaction

34. **Which of the following compound act as a reference compound in NMR spectroscopy?**
    (a) Acetic acid
    (b) Ethanol
    (c) Tetramethylsilane
    (d) Tetramethylethelenediamine

35. **You are centrifuging a homogenized sample at 20000 rpm for 20 min. What will you expect to found in the pellet?**
    (a) Unbroken cells
    (b) Nuclei
    (c) Mitochondria and chloroplast
    (d) Microsomes

36. **In EtBr-CsCl density gradient centrifugation, what will be the band position of three types of DNA?**
    (a) Linear DNA: top ; Nicked ds DNA: middle ; Supercoiled DNA : bottom
    (b) Linear DNA: bottom ; Nicked ds DNA: middle ; Supercoiled DNA: top
    (c) Nicked ds DNA : top ; Supercoiled DNA: middle ; Linear DNA : top
    (d) All of them will form band at the same position

37. **The commonly used amino acid in SDS PAGE buffer is**
    (a) Glycine
    (b) Tryptophan
    (c) Histidine
    (d) Isoleucine

38. **The void volume of the Gel-filtration column is 30ml. a monomeric protein with a known molecular weight of 25 kDa elutes at a volume of 45ml.The protein of your interest elutes at 35ml. Which of the following explanation is true?**
    (a) The protein is repelled by the column matrix
    (b) The protein is not monomeric in solution
    (c) The protein is disrupted during purification
    (d) None of the above

39. **In isoelectric focusing, separation of protein is based on**
    (a) Relative content of positively charged groups
    (b) Relative content of negatively charged groups
    (c) pH
    (d) both a and b

40. **Which of the following statement is true?**
    (a) Paper chromatography is usually considered to be quantitative only, while gas chromatography is both qualitative and quantitative
    (b) Paper chromatography and gas chromatography are both used for qualitative analysis only
    (c) Paper chromatography and gas chromatography are both used for quantitative analysis only
    (d) Paper chromatography is qualitative only, whereas gas chromatography is qualitative or quantitative.

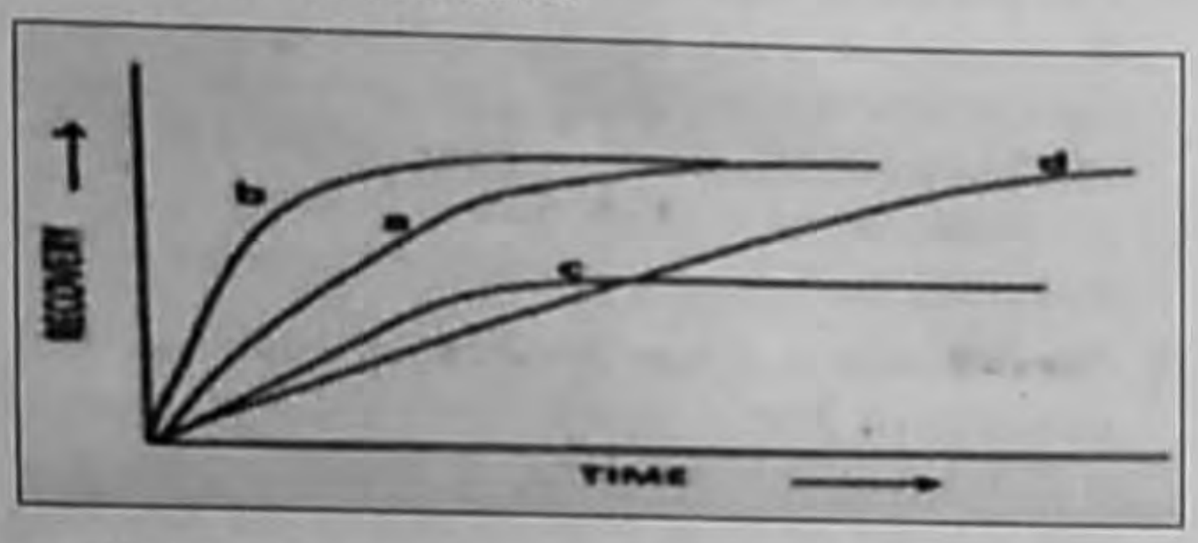
41. **In gas chromatography, concentration of a substrate can be determined by**
    (a) The R_t value of the substance
    (b) Measurement of the height of the peak produced by the substrate

(c) comparison of the area under the peak produced by the substance with the areas under the peaks produced by the standard
(d) comparison of the R_f of the substance with that of a standard

42. FRAP is used to determine the movement of membrane lipids as well as membrane proteins. The following were used as a fluorescently labelled molecule.

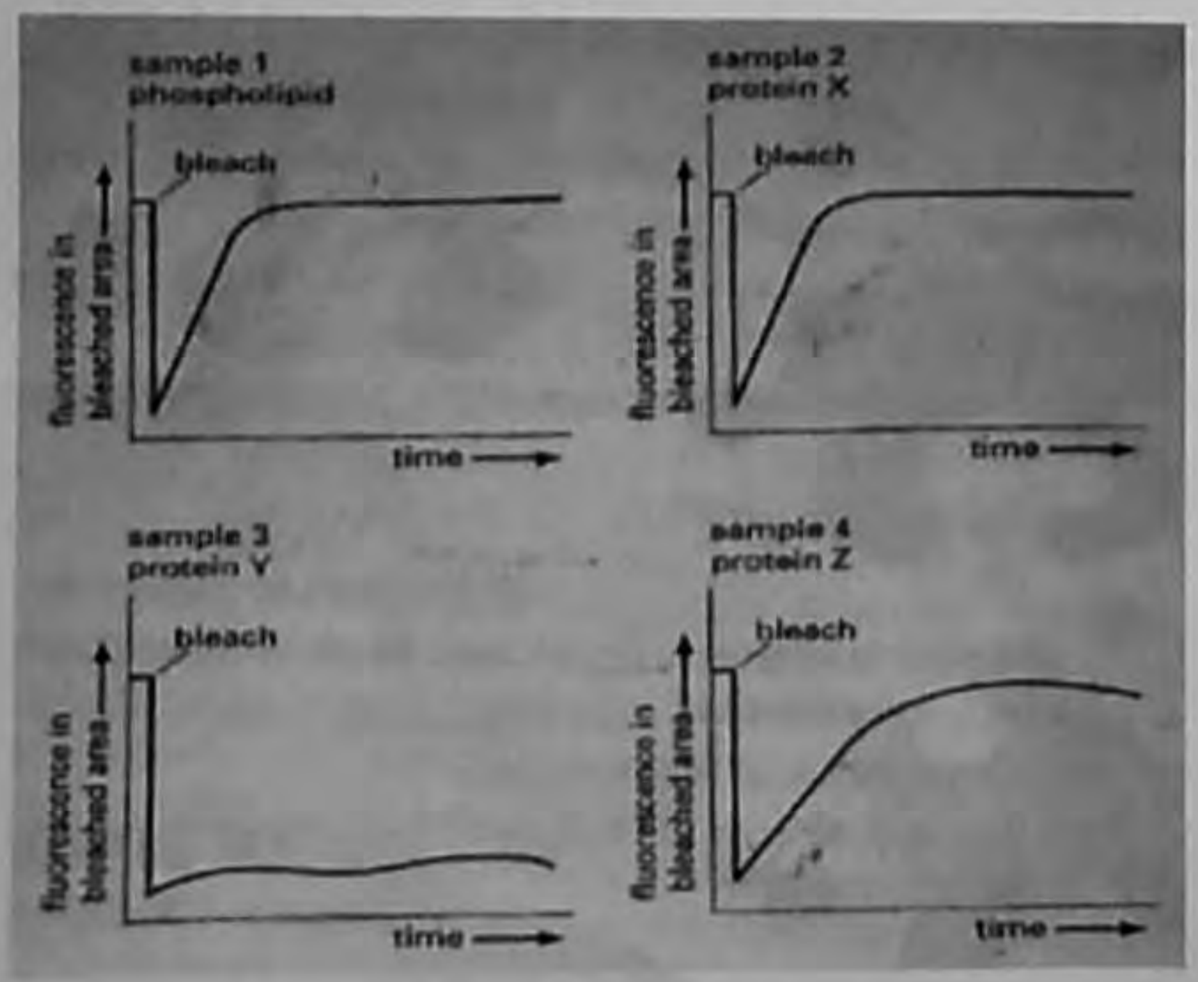
(a) A receptor tagged with GFP
(b) A receptor labelled with GFP that interacts with cytoskeleton
(c) A labelled lipid
(d) A labelled protein that binds to the membrane surface

They were photoleached and the recovery profile was obtained as follows:



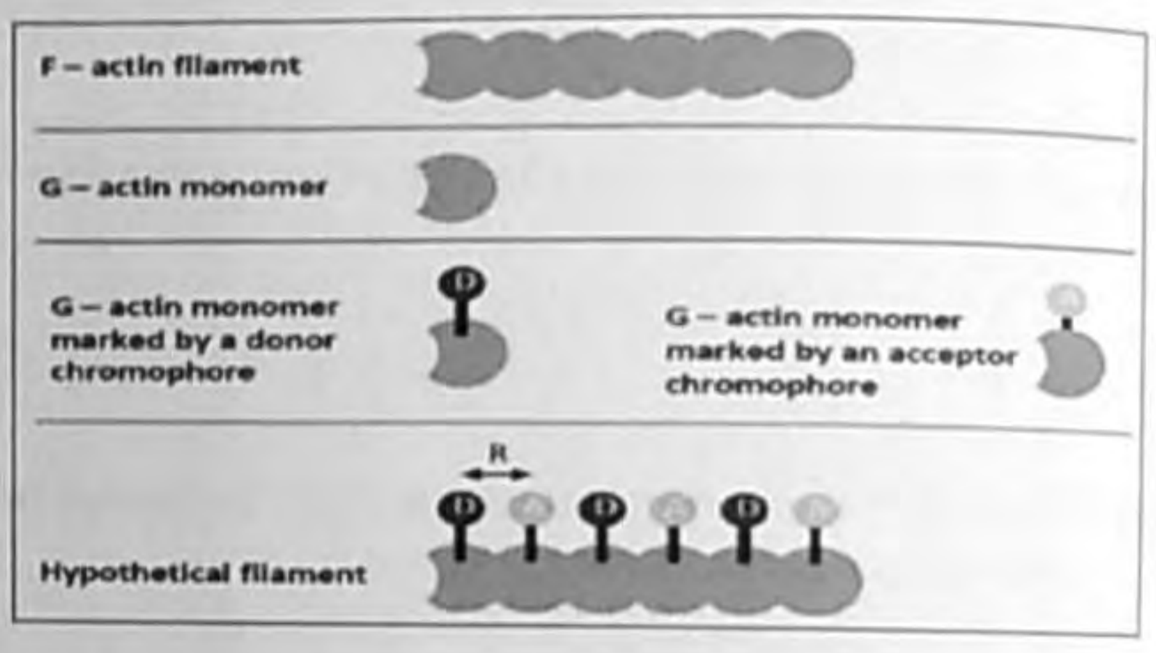
Which of the following combination is correct?
1. a-i, b-ii
2. b-iii, a-iv
3. c-iii, d-iv
4. b-i, d-ii

43. Uou have performed a FRAP to visualize diffusion within a membrane. In sample 1 you have flusoscently labelled a phospholipid. In samples 2, 3 and 4 you have fluroscently labelled membrane proteins X, Y and Z respectively. Photobleaching and recovery is shown in the below graphs.



Based on this graph order the proteins in their ability to diffuse in the membrane, from fastest to slowest.
1. X>Y>Z
2. Z>X>Y
3. Y>X>Z
4. X>Z>Y

44. The F-actin filament is composed by G-actin monomers. By attaching either a donor(D) or an acceptor(A) choromophore to the G-actin monomer and measuring the energy transfer efficiency to measure the average distance between G-actin monomers in a F-actin filment(asuming that the monomers are well arranged in DADADADA.... sequence), and one finds that the average energy transfer efficience is 23%. If the R_0 is 4.5 nm, what is the average distance between monomers in a filament?



(a) 5nm
(b) 6.5nm
(c) 5.5nm
(d) 7nm

45. Your research project involves protein-protein interactions. Which microscope technique should you use, with which fluroscent probes?

(a) FRAP using YFP and PI
(b) TIRF using DAPI and calcoflour M2R
(c) FRET using GFP and fluorescein
(d) FLIM using CFP and YFP

46. The energy transfer in FRET depends on

(a) The distance between two molecules
(b) The wavelength of the light
(c) The fluroscent probe
(d) All of the above

47. Patch-clamp technique is used to study

(a) Presence of transport protein in a membrane
(b) Presence of single or multiple ion channels
(c) Presence of a membrane receptor
(d) All of the above

48. Patch-clamp technique depends on

(a) Measuring the flow of ions through a channel
(b) The change in membrane potential
(c) The unitary conductance
(d) All of the above

49. The scattering contribution of one atom or ion to the total X-ray diffraction pattern is not given by which of the following property?

(a) The oxidation state
(b) The isotope
(c) The position of the atom/ion in the unit cell
(d) The vibrational motion of the atom/ion

50. What is meant by the 'Phase problem' in X-ray crystallography study?

(a) The sample must be in the crystalline solid phase
(b) The phase of an X-ray wave changes when it is scattered by an atom
(c) The relative phases of diffracted X-ray beams are lost when the diffraction pattern is recorded
(d) Non-centrosymmetric crystal structure always gives centrosymmetric diffraction patterns

51. Which of the following cannot be obtained from an X-ray crystallographic study?

(a) A bond angel Si-O-Si in a mineral
(b) The absolute configuration of a chiral natural product
(c) The vibration frequency of a carbonyl group
(d) The spacing between two parallel aromatic rings

52. How many signals does the aldehyde $(CH_3)_3CCH_2CHO$ have in ^1H NMR and in ^{13}C NMR spectra?

(a) Five ^1H signals and six ^{13}C signals
(b) Three ^1H signals and four ^{13}C signals
(c) Five ^1H signals and four ^{13}C signals
(d) Three ^1H signals and six ^{13}C signals

53. Which of the hydrogens (a-d) in the following molecule gives a triplet signal in a normal ^1H NMR spectrum?

(a) Hydrogen a
(b) Hydrogen b
(c) Hydrogen c
(d) Hydrogen d

54. Which of the following statement about NMR spectra is not true?

(a) Chemical shifts are larger when the frequencies of the radiation which induces the nuclear transitions are higher
(b) Chemical shifts are larger when the shielding effect is greater
(c) NMR signals towards the left of the spectral chart correspond to larger chemical shifts
(d) A hydrogen signal splits into n+1 spins by spin-spin coupling when the number of equivalent hydrogen atoms on adjacent atoms is n and no longer neighboring atoms are involved

55. Which of the following indicates the multiplicities for hydrogen on C1, C3 and C4 of butanone attributable to spin-spin coupling in its ^1H NMR spectrum?

(a) Hs on C1, singlet; Hs on C3, doublet; Hs on C4, triplet
(b) Hs on C1, singlet; Hs on C3, triplet; Hs on C4, quartet
(c) Hs on C1, singlet; Hs on C3, quartet; Hs on C4, triplet
(d) Hs on C1, triplet; Hs on C3, doublet; Hs on C4, triplet

56. How many signals does the following unsaturated ketone have in ^1H and ^{13}C spectra?

$(CH_3)_2CHCH_2C(O)CH = CH_2$

(a) Five ^1H signals and six ^{13}C signals
(b) six ^1H signals and six ^{13}C signals
(c) six ^1H signals and seven ^{13}C signals
(d) Five ^1H signals and seven ^{13}C signals

57. A ^1H NMR spectrum of a compound C contains a singlet, a triplet and a quartet. Which oh the following compound might C be ?

(a) $CH_3CH_2CHClCHCl_2$
(b) $CH_3CHClCHClCH_3$
(c) $CH_3CH_2CH_2CHCl_2$
(d) $CH_3CCl_2CH_2CH_3$

58. In mass spectrometer, the sample to be analyzed is bombarded with

(a) Electrons
(b) Protons
(c) Neutrons
(d) Alpha particles

59. Mass spectrometer separates the ions on the basis of

(a) Mass
(b) Charge
(c) Molecular weight
(d) Mass to charge ratio

60. In mass spectrometer, the ion currents are measured using which of the following?

(a) Scintillation counter
(b) Ion counter
(c) Electrometer tube
(d) Electric fields

61. Which of the following statement is not true about mass spectrometry?

(a) Impurities of masses different from the one being analyzed interferes with the result
(b) It has great sensitivity
(c) It is suitable for data storage
(d) It is suitable for library retrival

62. Which of the ions pass through the slit and reach the collecting plate?

(a) Negative ions of all masses
(b) Positive ions of all masses
(c) Negative ions of specific mass
(d) Positive ions of specific mass

63. Mass spectrometry starts with

(a) The sample is converted into gaseous state
(b) The ions are detected
(c) The sample is bombard by electron beams
(d) The ions are separated by passing them into electric and magnetic field

64. Which of the following is not a component of mass spectrometer?

(a) Inlet system
(b) Sweep generator
(c) Ion transducer
(d) Mass analyser

65. Which of the following process is usually done to convert the samples of mass spectrometer into gaseous phase?

(a) Sample is pressurized
(b) Chemical reactions are made to occur
(c) Sample is heated
(d) Sample is cooled

66. Which of the following statement is incorrect?

(a) Mass spectrometry gives information about fragmentation pattern
(b) Mass spectrometry provides direct structural data
(c) Isotopic distribution patterns are observed in mass spectra
(d) Parent ions are not always observed in the mass spectra of compounds

67. The base peak in a mass spectra is

(a) The highest mass peak
(b) The lowest mass peak
(c) The peak corresponding to the parent ion
(d) The peak set to 100% relative intensity

68. The main purpose of flow cytometry is to

(a) Amplify targeted short sequences of DNA or RNA
(b) Capture and evaluate colour in a solid or liquid to ensure colour accuracy
(c) Analyze light to determine cell or protein properties
(d) Replicates cell suspended in fluid

69. In flow cytometry, what does light emitted as side scatter measure?

(a) Cell size
(b) Cell granularity
(c) Cell shape
(d) Cell surface marker fluroscence

70. The forward light scatter in flow cytometry measures

(a) Cell size
(b) Cell shape
(c) Cell granularity
(d) Cell surface marker fluroscence

71. Which of the following antigen you can use in flow cytometric analysis to distinguish acute promyelocytic leukemia from other types of acute myeloid leukemia?

(a) CD13
(b) CD33
(c) CD117
(d) HLA-DR

72. The force applied on sedimenting particle at rotational movement is

(a) Centripetal force
(b) Gravitational force
(c) Rotational force
(d) Centrifugal force

73. Golgi apparatus (density = 1.11g/cm^3), mitochondria (density= 1.19g/cm^3), peroxisomes (1.23g/cm^3) can be best separated by

(a) Differential centrifugation
(b) Density gradient centrifugation
(c) Continuous centrifugation
(d) All of the above

74. The first fraction obtained at lowest centrifugation rate in differential centrifugation is

(a) Microsomes
(b) Nucleus
(c) Mitochondria
(d) Ribosomes

75. Which of the following compound is not used as gradient maker in density gradient centrifugation

(a) Sucrose
(b) Glycerol
(c) CsCl
(d) Maltose

76. MRI works under the principle of spectroscopy

(a) Spectrophotometer
(b) Mass spectroscopy
(c) Nuclear magnetic resonance
(d) Electron spin resonance

77. DNA molecules in combination with Ethidium Bromide gives λ max

(a) 280 nm
(b) 300 nm
(c) 360 nm
(d) 590 nm

78. According to Beer's law absorbance of any solution is proportional to

(a) Transmittance of light
(b) Concentration of solution

(c) Pathlength
(d) Wavelength

79. The cuvette used for analysis of sample at UV range is

(a) Glass cuvette
(b) Quartz
(c) Silica
(d) Any of the above

80. Which of the following information can't be generated from electrophoresis

(a) Purity
(b) Molecular weight
(c) Concentration
(d) pI value

81. The staining reagent in protein electrophoresis is

(a) CBB G
(b) CBB G250
(c) CBB R250
(d) CBB M250

82. Plasma proteins are isolated by

(a) Salting out
(b) Electrophoresis
(c) Fluorimetry
(d) Both a and b

83. The tracking dye used in column chromatography is

(a) Bromophenol blue
(b) Blue dextran
(c) Phenol red
(d) All of the above

84. Which of the following is/are used as thin layer absorbent in TLC

(a) Silica
(b) Cellulose
(c) Alumina
(d) All of the above

85. Carbohydrates are visualized in TLC by reacting with

(a) Aniline reagent
(b) Ninhydrin
(c) Iodine
(d) All of the above

86. The ratio of velocity (v) of biomolecules in a medium under constant electric field (E) is called electrophoretic mobility denoted as μ. μ can be expressed as

(a) $\mu = E/v$
(b) $\mu = v/E$
(c) $\mu = 1/Ev$
(d) $\mu = VE$

87. The main advantage of discontinuous buffer system in SDS and native PAGE is

(a) Conformation of protein is conserved
(b) Constantly maintain the charge of proteins
(c) Assist the migration of proteins
(d) Enhance resolution of separation

88. The percentage of SDS commonly used in the buffers of SDS-PAGE is

(a) 0.1%
(b) 1.0%
(c) 10%
(d) 1-10%

89. The role of urea in PAGE separation of DNA is to

(a) Act as anion
(b) Act as cation
(c) Helps to denature the DNA
(d) Provide buffer stability of the gel

90. The pH of stacking, resolving gel and tank buffer in SDS-PAGE is respectively

(a) 8.30, 8.80 and 6.80
(b) 6.80, 8.80 and 8.30
(c) 8.30, 6.80 and 8.80
(d) 6.80, 8.30 and 8.80

91. The tracking dye used in SDS-PAGE is

(a) Anionic
(b) Cationic
(c) Non-ionic
(d) Amphipathic

92. A TLC technique that uses centrifugal forces to accelerate the solvent flow from the centre of the plate

(a) RPC
(b) HPTLC
(c) Bonded phase chromatography
(d) Adsorption chromatography

93. Analytes that are extremely hydrophobic , a mobile phase that contains no water is used. The separation is termed as

(a) Reversed phase chromatography
(b) Normal phase chromatography
(c) Non-aqueous Reversed phase chromatography
(d) Aqueous Normal phase chromatography

94. You are analyzing a complex mixture of compounds with the help of TLC. A column of spots is seen on the developed plate. Which of the following do you expect to observe?

(a) More polar compounds toward the top of the plate and less polar towards the bottom
(b) More polar compounds towards the bottom of the plate and less polar toward the top
(c) Lower boiling compounds towards the bottom of the plate and higher boiling toward the top
(d) Lower boiling compounds toward the top of the plate and higher boiling toward the bottom

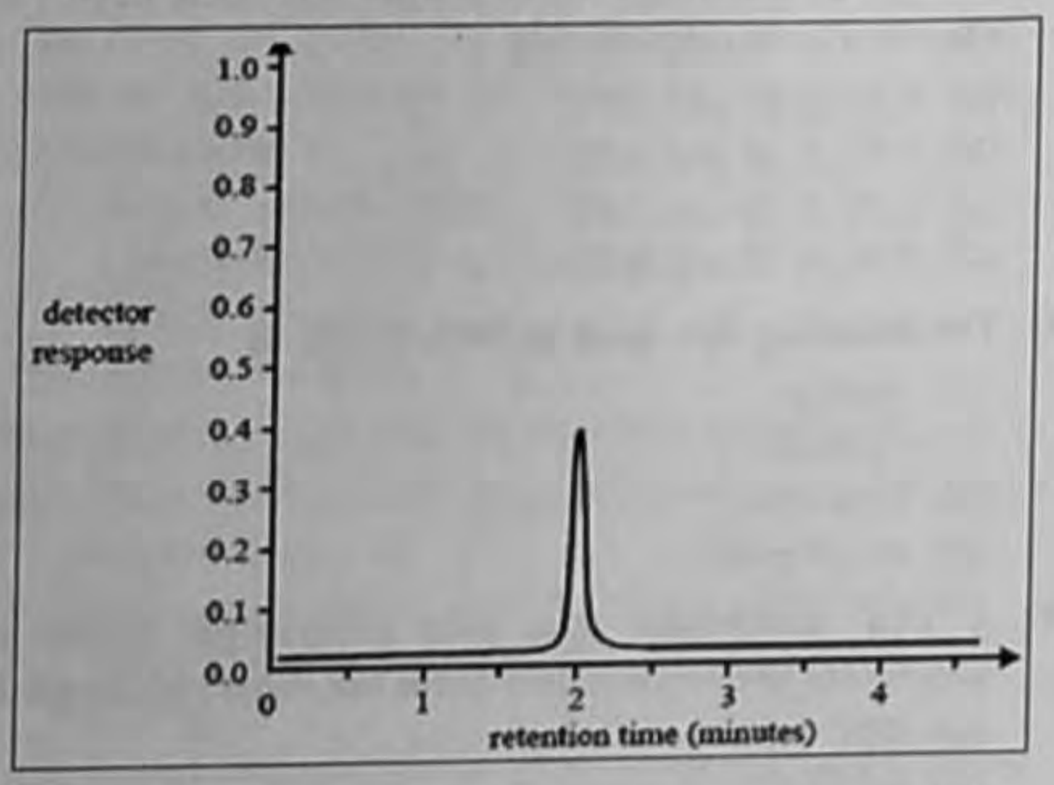
95. In GC retention depends on the

(a) Vapour pressure and polarity of the solute
(b) Size and charge of the solute
(c) The type of detector used
(d) The type of column used

96. A forensic chemist tests mud from a crime scene to determine whether the mud contains zinc. Which one of the following analytical techniques would be best suited to this tusk?

(a) IR spectroscopy
(b) NMR spectroscopy
(c) Thin layer chromatography
(d) Atomic absorption spectroscopy

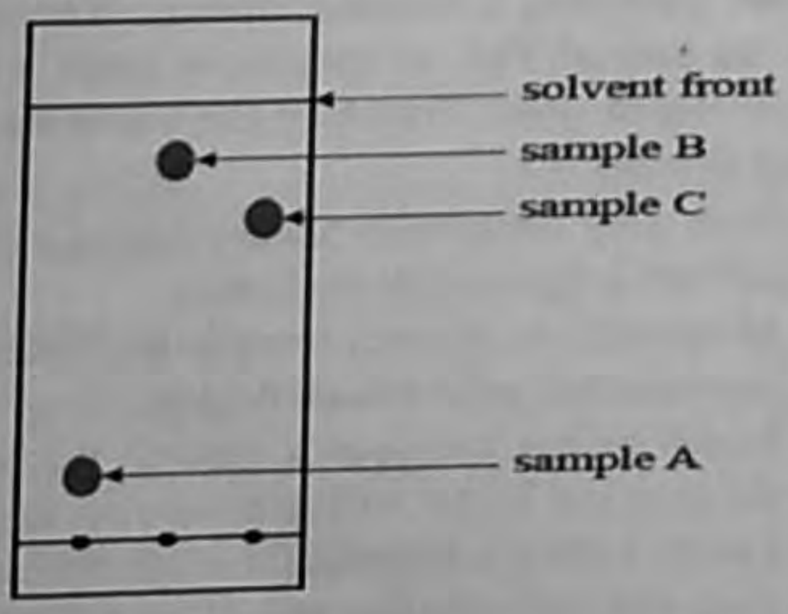
97. HPLC is used to determine the amount of caffeine in a sample of a soft drink. The chromatogram below shows the detector response when the standard solution of caffeine with a concentration of 200 mg/L was measured using the instrument.



What is the retention time of caffeine in this experiment?

(a) 5 min
(b) 2 min
(c) 4 min
(d) 3 min

98. The thin layer chromatography plate shown below has a polar stationary phase. It was developed using hexane as the solvent.



Which sample has the most polar molecules?

(a) Sample A
(b) Sample B
(c) Sample C
(d) There is not enough information to determine which sample has the most polar molecules

99. Two proteins interact in a cell during a signaling pathway. Which of the following technique is used to determine the interaction between them?

(a) FRET
(b) FRAP
(c) SDS-PAGE
(d) Footprinting

100. SDS-PAGE analysis under complete reducing environment of a dimeric IgA molecule will produce

(a) One protein band
(b) Four protein bands
(c) Two protein bands
(d) Three protein bands

Answers

1. c	21.d	41.c	61.a	81.c
2. a	22.a	42.2	62.d	82.d
3. a	23.c	43.1	63.a	83.b
4. a	24.a	44.c	64.b	84.d
5. d	25.c	45.c	65.c	85.a
6. d	26.b	46.d	66.b	86.b
7. c	27.b	47.b	67.d	87.d
8. a	28.a	48.d	68.c	88.a
9. b	29.c	49.b	69.b	89.c
10. c	30.b	50.c	70.a	90.b
11. d	31.d	51.c	71.d	91.a
12. a	32.a	52.b	72.d	92.a
13. a	33.a	53.c	73.b	93.c
14. c	34.c	54.b	74.b	94.b
15. b	35.c	55.c	75.d	95.a
16. c	36.a	56.b	76.c	96.d
17. b	37.a	57.d	77.d	97.b
18. d	38.b	58.a	78.b	98.a
19. b	39.d	59.d	79.b	99.a
20. c	40.d	60.c	80.c	100.b