

類組：化學類 科目：分析化學(1005)

※請在答案卡內作答

Multiple choice (#1 - #15. 4% each. Only one answer is correct. No penalty for incorrect answers)
選擇題，1-15 題，每一題四分，每題只有一個正確答案，答錯不倒扣

1) A Nd/YAG laser (emission at 1064nm) is used as the excitation source for Raman spectroscopy due to:
(A) its very powerful source intensity to enhance the Raman scattering. (B) its longer wavelength to avoid creating fluorescence. (C) the extremely-high sensitive photon transducer available for this radiation wavelength. (D) the fact that the Raman scattering intensity is proportional to the wavelength of the incident light; the longer the wavelength the higher the Raman scattering. (E) none of the above.

2) Which of the following is not one of the properties related in using supercritical fluid extraction (using CO₂) for analytical sample pre-treatment compared with conventional Soxhlet extraction?
(A) higher extraction speed for low-polarity components (B) higher extraction speed for high-polarity components (C) tunable solvation power by changing applied pressure (D) less organic solvent needed for extraction (E) lower viscosity compared with organic solvents.

3) Which of the following instruments may be used to measure the optical activity of compounds?
(A) mass spectrometer (B) infrared spectrometer (C) nuclear magnetic resonance spectrometer (D) atomic absorption spectrometer (E) polarimeter.

4) Which of the following is a background correction method for atomic absorption spectroscopy?
(A) internal standard calibration method (B) double beam method (C) releasing-agent method (D) self-reversal method (E) Fourier transform method

5) A hollow cathode lamp is used in atomic absorption spectrometry (AAS) due to
(A) its small light spot to fit the narrow slit width in AAS (B) its excellent sharpness to match the high resolution of the monochromator in AAS (C) its narrow bandwidth to provide good detection sensitivity (D) its high wavelength precision to match the atomic line (E) its high intensity to give good detection limit.

6) Which of the following is not the reason for the excellent detection sensitivity of an ICP/MS (inductively coupled-plasma/mass spectrometer)?
(A) ICP is a multielement detection device (B) ICP is a good ionization device (C) ICP is a good atomization device (D) ion detectors are very sensitive in a MS (E) none of the above.

7) Fourier transform infrared spectrometer (FT-IR) demonstrates several advantages over dispersive IR. Which of the following is not one of the advantages?
(A) multiplex advantage (B) throughput advantage (C) Conne's advantage (D) Zeeman advantage (E) all of the above are advantages.

8) Capillary electrophoresis has been applied in separating neutral molecules using a related technique called:
(A) capillary gel electrophoresis (B) capillary electrochromatography (C) micellar electrokinetic capillary chromatography (D) capillary zone electrophoresis (E) capillary isoelectric focusing

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參考用

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- 9) The wavenumber of the fundamental O-H stretching vibration is about 7100 cm^{-1} .
What is the approximate wavenumber of the first overtone peak for the O-H stretch?
(A) 3550 cm^{-1} (B) 7100 cm^{-1} (C) 14200 cm^{-1} (D) 21300 cm^{-1} (E) none of the above
- 10) A three-electrode instead of a two-electrode cell is usually used for voltammetric measurements to:
(A) get precise voltage reading applied on the indicator electrode (B) get precise current reading applied on the indicator electrode (C) get precise resistance reading applied on the indicator electrode (D) get precise voltage reading applied on the reference electrode (E) get precise current reading applied on the reference electrode
- 11) Detection sensitivity is enhanced using stripping methods in voltammetry, because (A) the charging current is greatly reduced (B) the analyte is greatly concentrated on the indicator electrode (C) the signal-to-noise ratio is greatly increased by multiple scanning (D) the nonfaradaic current is greatly reduced. (E) a peak instead of a S-shaped signal is obtained.
- 12) Which atomic spectrometry would you use to detect Cd in a small blood sample ($\sim 10\text{ }\mu\text{L}$)?
(A) flame atomic emission spectrometry (B) flame atomic absorption spectrometry (C) glow-discharge emission spectrometry (D) inductively-coupled plasma/mass spectrometry (E) electrothermal atomic absorption spectrometry.
- 13) Homonuclear spin-spin coupling of ^{13}C - ^{13}C is usually not observed in ^{13}C nuclear magnetic resonance, because
(A) the natural isotopic abundance of the isotope is very low (B) the magnetogyric ratio is very small (C) the chemical shift range is inherently high (D) an extremely high magnetic field is required and actually not available (E) none of the above.
- 14) The fluorescence band for a given electronic transition of a species is displaced toward lower frequencies or longer wavelengths from the absorption band. This phenomenon is called
(A) green shift (B) blue shift (C) Raman shift (D) Stokes shift (E) anti-Stokes shift
- 15) Which of the following is not associated with an ion-exchange chromatography?
(A) ion separations (B) protein separations (C) suppressor column (D) ion-pair formation (E) conductivity detection

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Multiple choice (#16 - #25. 4% each. Mark out all correct answers. No penalty for incorrect answers)

選擇題，16-25 題為複選題，每一題四分，選出所有正確答案，答錯不倒扣

16) Molecular vibrational energy levels can be obtained via

(A) magnetic resonance spectroscopy (B) Raman spectroscopy (C) UV/Vis absorbance spectroscopy (D) infrared spectroscopy (E) X-ray diffraction spectroscopy.

17) Which technique in the following would you apply to determine the concentration of Fe^{3+} and Fe^{2+} separately in an aqueous solution?

(A) flame atomic absorption spectroscopy (B) inductively-coupled plasma (ICP)/mass spectroscopy (C) differential-pulsed polarography (D) photoacoustic spectroscopy in the visible region (E) reversed-phase chromatography.

18) Which of the following detectors have not been used in gas chromatography?

(A) mass spectral detector (B) thermal couple detector (C) electron capture detector (D) FT-IR detector (E) UV/Vis absorbance detector

19) Which of the following detectors would be suitable when a gradient elution is performed in a liquid chromatography?

(A) UV/Vis detector (B) evaporative light scattering detector (C) fluorescence detector (D) mass spectral detector (E) refractive index detector.

20) Matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) mass spectrometry is now a powerful tool for researching biomolecules. Which of the following statements are true?

(A) Because of its pulsed nature, MALDI technique is well suited to the TOF mass analyzer. (B) The Nobel Prize in Chemistry was awarded to a scientist in 2002 for his contribution in MALDI. (C) Generally, the analyte molecules do not tend to be fragmented in the ionization process. (D) In MALDI, the analyte molecules absorb the irradiation of laser directly, and the matrix molecules act as the electron donor for ionization. (E) In MALDI, the matrix molecules absorb the irradiation of laser and transfer some energy to the analyte molecules to form gaseous ions.

21) Some elements form volatile hydrides in acidic solution with NaBH_4 and then are introduced into an atomizer for atomic absorption analysis. This technique is used to separate the analyte from the sample matrix and improve the detection limit. It is usually applied to the analysis of

(A) As (B) Ca (C) Li (D) Sb (E) Fe

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22) Which of the following statements about flame atomic spectrometry are false?

(A) Molecular band emission causes no interference in flame atomic emission spectrometry. (B) Atomic emission is more sensitive to flame instability than atomic absorption or fluorescence. (C) Organic solvents in the sample solution may alter the nebulization efficiency, but not affect the atomization process. (D) Flame atomic absorption spectrometry usually provides better measurements precision than that of electrothermal (graphite furnace) atomic absorption spectrometry. (E) An ionization suppressant is a readily ionized species, such as K, that produces a high concentration of electrons in a flame and represses ionization of the analyte.

Answer the following three consecutive questions with respect to analyzing homologs of organic acids, $C_nH_{2n+1}COOH$ ($n = 1,2,3,4$) using chromatographic techniques.

23) Why would you not directly apply a so-called C18 reversed-phase liquid chromatographic column for this separation?

(A) the polarities of the compounds are too large (B) organic acids will destroy the column (C) the molecular weights of the compounds are too small to be retented on the stationary phase (D) the reversed-phase chromatography is inadequate for any homolog separations (E) the compounds are almost not retented on the stationary phase.

24) Which of the following would you suggest if liquid chromatographic techniques must be applied?

(A) normal-phase partition chromatography (B) ion-pair chromatography (C) affinity chromatography (D) size-exclusion chromatography (E) chiral stationary-phase chromatography.

25) Which of the following would you suggest if gas chromatographic techniques must be applied?

(A) using very high oven temperature during elution (B) applying very high temperature at the sample injector before sample injection (C) using temperature programming during the complete elution (D) making the acids into ester derivatives before sample injection (E) applying open-tubular column instead of packed-column.

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