類組：化學類　科目：分析化學(1005)　　　　　　　共 ７ 頁 第 １ 頁

※請在答案卡內作答

選擇題(單選題，共 40 題，每題 2.5 分，答錯不倒扣)

1. For a data value set that is Gaussian distributed, what is the likelihood (%) that a data point will be within ±2 SD from the mean?
   A. 68%　　B. 99%　　C. 95%　　D. 100%　　E. 50%

2. Which of the following statistical test should be applied to determine whether the outlier should be retained or rejected?
   A. Student's $t$-test　　B. Fisher's F-test　　C. Dixon's Q-test　　D. Paired $t$-test　　E. $z$-test

3. The equation for a normal calibration curve for the detection of iron(II) ions is determined experimentally to be: y = 20x + 3. The measurement of 10 reagent blanks gives a standard deviation of 2. What are the limit of detection (LOD) and limit of quantification (LOQ) of this analytical method?
   A. 0.5, 2.0　　B. 0.3, 1.0　　C. 1.0, 3.5　　D. 0.6, 1.5　　E. 1.0, 2.0

4. Which of the following analytical method does not require a calibration curve?
   A. Gravimetric method　　B. Absorption spectroscopy　　C. Mass spectrometry
   D. Fluorescent spectroscopy　　E. Gas chromatography

5. Which of the following technique has the highest potential sensitivity?
   A. Absorption　　B. Fluorescence　　C. Turbidimetry　　D. Nephelometry　　E. Radioactivity

6. Concentrated hydrochloric acid is 12 M and has a density of 1.18 g/mL. What is the weight percent (% w/w) of concentrated HCl?
   A. 14%　　B. 5.1%　　C. 12%　　D. 98%　　E. 37%

7. Which of the following types of liquid chromatography uses immobilized biochemical molecules as the stationary phase?
   A. Ion exchange chromatography　　B. Exclusion chromatography
   C. Affinity chromatography　　D. Gel permeation chromatography
   E. Gas chromatography

8. Which of the following is the wave number of near infrared spectrometer?
   A. $4000 - 200 \ cm^{-1}$　　B. $200 - 10 \ cm^{-1}$　　C. $12500 - 4000 \ cm^{-1}$　　D. $1000 - 50 \ cm^{-1}$　　E. $10 - 1 \ cm^{-1}$

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9. Which of the following condition will cause the efficiency of the column to increase?

   A. Plate number becomes greater, plate height becomes smaller

   B. Plate number becomes smaller, plate height becomes smaller

   C. Plate number becomes smaller, plate height becomes larger

   D. Plate number becomes greater, plate height becomes larger

   E. None of the above

10. The time required for a molecule of the mobile phase to pass through the column is called the

    _____.

    A. Dead time　　B. Solute migration rate　　C. Adjusted retention time

    D. Retention time　　E. Elution time

11. In glucose electrode, glucose oxidase has been coupled to an electrode by which of the following materials?

    A. Gluconic acids　　B. Urease　　C. Polyacrylamide　　D. Biochips　　E. Ferrocene derivatives

12. Which of the following condition(s) will affect the particle size of a precipitate?

    A. Solubility　　B. Temperature　　C. Reactant concentrations

    D. Rate at which reactants are mixed　　E. All of the above

13. NMR is the study of absorption of _____ by nuclei in a magnetic field?

    A. Radioactive radiation　　B. IR radiation　　C. Radio frequency radiation

    D. Microwaves　　E. magnetization force

14. Standard hydrogen electrode, which is the reference electrode, can be used as which of the following?

    A. Anode only　　B. Cathode only　　C. Anode and cathode　　D. Salt bridge　　E. Counter electrode

15. Which electrochemical assay measures current at a fixed potential?

    A. Anodic stripping voltammetry

    B. Coulometry

    C. Amperometry

    D. Analysis with ion-selective electrodes (ISEs)

    E. Electrophoresis

16. What is the ionic strength of a solution that has 0.05 M $KNO_3$ and 0.1 M $Na_2SO_4$?

    A. 0.55 M　　B. 0.35 M　　C. 0.80 M　　D. 1.00 M　　E. 0.40 M

17. How many grams of $AgNO_3$ is needed to prepare a 2.0 L aqueous solution of 0.05 M $AgNO_3$ (MW: 169.87 g/mol)?

    A. 8.493 g　　B. 80.493 g　　C. 33.974 g　　D. 1.698 g　　E. 16.987 g

18. Which of the following concentration is equivalent to 329.3 ppm of $K_3Fe(CN)_6$ (MW: 329.3 g/mol)?

    A. 329.3 μM　　B. 329.3 mM　　C. 329.3 g/L　　D. 329.3 mg/L　　E. 329.3 μg/L

19. How is absorption related to transmittance?

    A. Absorption is the logarithm of transmittance

    B. Absorption is the reciprocal of transmittance

    C. Absorption is the negative logarithm of transmittance

    D. Absorption is a multiple of transmittance

    E. Absorption is inversely proportional of transmittance

20. What is the unit of absorbance that can be derived from the Beer Lambert's law?

    A. $Lmol^{-1}cm^{-1}$　　B. $LM^{-1}cm^{-1}$　　C. $LM^{-1}m^{-1}$　　D. $Lmol^{-1}m^{-1}$　　E. No unit

21. The function of photomultiplier tube is:

    A. to multiply photons in detection system.

    B. to convert electron beam to photon beam, and then multiply photons.

    C. to convert photon beam to electron beam, and then multiply electrons.

    D. to focus incoming light in order to improve sensitivity.

    E. to separate light into constituent wavelengths.

22. In atomic absorption spectrometry, absorbance of Cr line decreases as the distance from the flame base increases. This phenomenon is normally explained by:

A. formation of very stable Cr oxides

B. excitation of Cr atoms due to a longer exposure to high temperatures

C. de-excitation of Cr atoms

D. radioactive decay of Cr

E. a greater number of Cr atoms away from the flame base

23. How can one perform *background correction based on source self-reversal (Smith-Hieftje method)* in atomic absorption spectrometry?

A. reverse the direction of light beam

B. apply two light sources and a rotating chopper to switch between them

C. apply magnetic field to the incident light beam

D. alternately increase and decrease current of HCL lamp

E. rotate polarizer placed in front of HCL lamp

24. In trace analyses by atomic emission spectrometry, which of the following devices is often used to excite atoms to produce light?

A. mercury lamp　　B. tungsten lamp　　C. deuterium lamp

D. inductively coupled plasma torch　　E. proton gun

25. Which type of radiation is most widely used by chemists to observe differences between vibrational energy levels in molecules present in the liquid phase?

A. X-rays　　B. vacuum ultraviolet light　　C. ultraviolet light　　D. blue light　　E. infrared light

26. According to the Beer's Law:

A. absorbance does not depend on concentration

B. absorbance is directly proportional to concentration

C. absorbance is proportional to decimal logarithm of concentration

D. fluorescence intensity does not depend on quantum yield

E. fluorescence intensity does not depend on absorbance

27. The electronic transition called *intersystem crossing* is required for:

A. ionization　　B. absorption　　C. fluorescence　　D. phosphorescence　　E. charge transfer

28. Which of the following light sources is not applicable to infrared absorption spectrometry?

A. Nernst glower　　B. Globar　　C. incandescent wire source　　D. mercury arc　　E. deuterium lamp

29. Which of the following materials cannot be used to make optical elements for infrared spectrometers operating at the wavelengths from 2 to 10 $\mu$m?

A. sodium chloride　　B. silicate glass　　C. KBr　　D. TlBr / TlI　　E. ZnSe

30. Which four out of five ionization techniques listed below are mainly utilized in molecular mass spectrometry but are not normally utilized in atomic mass spectrometry?

(1) electron ionization; (2) electrospray ionization; (3) inductively coupled plasma; (4) matrix-assisted laser desorption/ionization; (5) desorption electrospray ionization.

A. 1, 2, 3, 5　　B. 1, 2, 4, 5　　C. 2, 3, 4, 5　　D. 1, 3, 4, 5　　E. 1, 2, 3, 4

31. What processes are involved in electrospray ionization?

A. Sample is sprayed into a zone of plasma; analyte molecules react with the reactive species present in the plasma, and electric charge transfer occurs leading to release of gaseous ions.

B. Sample is infused through a needle at an electric potential; droplets with an electric charge excess are formed; solvent evaporates; droplets split into smaller droplets; gas-phase ions are released.

C. Sample is irradiated with laser light; energy is absorbed by analyte atoms; the energy is released by detachment of electrons from neutral atoms.

D. Sample is sprayed into a cloud of energetic electrons emanating from a heated filament; analyte molecules absorb the electrons, and acquire electric charge.

E. Sample is directly sprayed into electric sector mass analyzer; ionization and ion separation occur simultaneously.

32. When a solution of a protein is analyzed by electrospray ionization mass spectrometry, many peaks normally appear in the mass spectrum. What is the best explanation of this phenomenon?
   A. Protein molecules get fragmented due to the interactions with energetic electrons.
   B. Protein molecules get fragmented in the presence of electric field.
   C. Protein molecules get fragmented in the presence of vacuum.
   D. Protein molecules are charged with varied numbers of charge carriers.
   E. Protein molecules arrive in the Taylor cone at different times.

33. What is the main purpose of implementing double-focusing analyzer in mass spectrometer?
   A. To minimize directional and energy aberrations of a population of ions.
   B. To make the mass analyzer compatible with electron ionization source.
   C. To increase the $m/z$ range of measurements.
   D. To circumvent the use of electric field.
   E. To circumvent the use of high vacuum.

34. Which mass analyzer is suitable for *tandem-in-time* mass spectrometry?
   A. electric sector　　B. magnetic sector　　C. quadrupole　　D. ion trap　　E. time-of-flight

35. Which of the following detectors is most often used with time-of-flight mass analyzer?
   A. photoconductor
   B. Faraday cage
   C. photomultiplier tube
   D. photodiode
   E. microchannel plate electron multiplier

36. One can say that the efficiency of a chromatographic separation is high if:
   A. theoretical plate height is small
   B. theoretical plate height is large
   C. number of theoretical plates is small
   D. peak width is large
   E. peak amplitude is high

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37. In liquid chromatography, low resistance to mass transfer can be achieved by using columns packed with very small stationary-phase particles (< 3 μm). Why do chemists still use larger stationary-phase particles in most applications?
   A. Because using columns with larger particles provides lower limits of detection.
   B. Because small particles prevent detection by UV absorption.
   C. Because small particles cause high backpressure.
   D. Because small particles have small surface area.
   E. Because small particles have insufficient number of reactive groups to support separation.

38. What would be the elution order of the four solutes (A, B, C, and D) in reversed-phase liquid chromatography? The solute polarities are: A > B > C > D.
   A. first A, then B, then C, finally D
   B. first B, then A, then D, finally C
   C. first C, then D, then A, finally B
   D. first D, then C, then B, finally A
   E. Solute polarities do not influence elution order in this type of chromatography.

39. What is the main limitation of conductivity detector used in ion chromatography?
   A. Such detectors are large and expensive.
   B. Such detectors do not respond in predictable way to analyte concentration changes.
   C. It requires an ion source to ionize the mobile-phase components.
   D. It requires a suppressor to minimize the interference from highly conductive mobile phase.
   E. It requires a guard column to minimize the interference from organic species.

40. Why do some anions migrate toward negative electrode in capillary electrophoresis?
   A. Because the electric field in capillary electrophoresis is too weak to affect anions.
   B. Mainly due to hydrodynamic flow present in most electrophoresis systems.
   C. Mainly due to diffusion.
   D. Mainly due to the presence of electroosmotic flow in thin silica capillaries.
   E. This phenomenon has never been explained in the scientific literature.