

一、單選題：每題 4 分，共 100 分 (選擇題答案請填於答案卡)。

1. For gravimetric analysis and argentometric titration, which of the following statements are **correct**?

- (1) At the equivalence point, the  $pAg^+$  is dependent of the original concentrations or volumes.
- (2) At the equivalence point, the  $pAg^+$  can be found by the solubility product of the precipitate.
- (3) The larger the equilibrium constant for a titration reaction, the more pronounced will be the change in concentration near the equivalence point.
- (4) The equivalence point is always at the center of the steepest section of the titration curve no matter of the stoichiometry of reactants.
- (5) The change in  $pAg^+$  at the equivalence point becomes greater as the solubility products become smaller.

Your answer: A. (2), (4) and (5); B. (2) and (3); C. (2), (3) and (5); D. (2) and (5);  
E. The statements are all correct.

2. For ionic strength and activity coefficients, which of the following statements are **correct**?

- (1) For 1:1 electrolytes, ionic strength equals the molarity.
- (2) The larger the ion size, the less important activity effects become.
- (3) Activity coefficients decrease with increasing ionic strength.
- (4) Activity coefficients are assumed to be zero for neutral molecules.
- (5) The greater the ionic strength of the solution, the lower the charge in each ionic atmosphere.

Your answer: A. (1), (2) and (3); B. (1) and (3); C. (1), (3) and (5); D. (3) and (4);  
E. The statements are all correct.

3. Kjeldahl nitrogen analysis is one of the most widely used methods for the determination of nitrogen in organic substances. Which reaction **is not involving** in this analysis:

- A. Kjeldahl digestion by  $H_2SO_4$  and boiling  $\text{organic C, H, N} \rightarrow NH_4^+ + CO_2 + H_2O$
- B. Neutralization of  $NH_4^+$   $NH_4^+ + OH^- \rightarrow NH_3(g) + H_2O$
- C.  $NH_3$  gas reaction with excess standard HCl  $NH_3 + H^+ \rightarrow NH_4^+$
- D. Distillation of  $NH_3$  into standard NaOH  $NH_3 + HO^- \rightarrow NH_4OH$
- E. Titration of unreacted HCl  $H^+ + OH^- \rightarrow H_2O$

4. Which of the following statements regarding EDTA titration are **correct**?

- (1) Back-titration should be used if analyte does not have satisfactory indicator.
- (2) If the pH is lowered, the conditional formation constant decreases, and the end point becomes more distinct.
- (3) The pH cannot be raised arbitrarily high, because metal hydroxide might precipitate.
- (4) Anions that precipitate with certain metal ions can be analyzed with EDTA by displacement titration method.
- (5) Trivalent cations can usually be titrated without interference from divalent species by maintaining the solution even at a pH = 1.

Your answer: A. (1) and (5); B. (1), (3) and (5); C. (1), (3) and (4); D. (2), (4) and (5);  
E. (1), (2) and (3).

5. For **solvent extraction**, which of the following statements **are correct**?

- (1) For neutral analytes, many small extractions are less effective than few large extractions.
- (2) The larger the partition coefficient ( $[S]_2/[S]_1$ ) of a neutral analyte, the less the analyte remain in phase 2.
- (3) To extract the base analytes into organic phase, use a pH high enough to convert  $BH^+$  into B.
- (4) To extract the acid HA into organic phase, use a pH low enough to convert  $A^-$  into HA.
- (5) Most complexes that can be extracted into organic solvent are neutral, and charged complexes are less soluble in organic solvents.

Your answer: A. (1), (3) and (4); B. (2) and (3); C. (3), (4) and (5); D. (3) and (4);  
E. The statements are all correct.

6. For solid-phase microextraction (SPME), which of the following parameters **could not be concerned**?

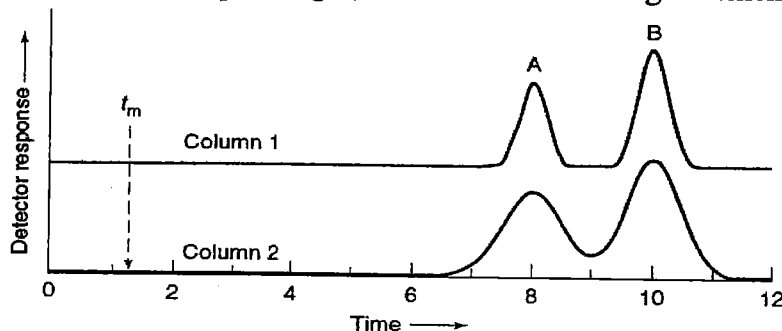
- A. type of SPME fiber;
- B. pH of sample;
- C. extraction time;
- D. volume of sample;
- E. extraction temperature.

7. For the van Deemter equation and band broadening terms, which of the following statements are **correct**?

- (1) Multiple path present in an open tubular column.
- (2) Longitudinal diffusion increases with diffusion coefficient of solute.
- (3) Extra column band broadening depends on length and radius of connecting tubing.
- (4) Equilibration time in stationary phase increases with thickness of stationary phase film.
- (5) Equilibration time in mobile phase depends on radius of open tubular column.

Your answer: A. (2), (3), (4) and (5); B. (2), (4) and (5); C. (3), (4) and (5);  
D. (2) and (5); E. The statements are all correct.

8. Chromatograms of compounds A and B were obtained at the same flow rate with two columns of equal length, which of the following statement **is not correct**?



- A. Column 1 has more theoretical plate.
- B. Column 2 has a smaller plate height.
- C. Column 1 gives higher resolution.
- D. Compound B has a higher retention factor.
- E. Relative retention is equal for the two columns.

9. Which of the following GC detector is especially sensitive to **compounds containing nitrogen and phosphorus**.

- A. Electron capture detector;
- B. Flame ionization detector;
- C. Flame photometric detector;
- D. Photoionization detector;
- E. Alkali flame detector.

10. Which of the following statements about the elution process of LC **is not true**?
- A. In normal-phase LC, the least polar analyte is eluted first because it is the most soluble in the mobile phase.
  - B. In normal-phase LC, a less polar solvent has higher eluent strength.
  - C. Increasing the polarity of the mobile phase has the effect of decreasing the elution time in normal-phase LC.
  - D. In reversed-phase LC, a more polar solvent has lower eluent strength.
  - E. In reversed-phase LC, increasing the mobile phase polarity increases the elution time of the less polar analyte.
11. For electrophoresis and electroosmosis, which of the following statement **is not true**?
- A. Electrophoretic mobility is the constant of proportionality between the speed of the ion and electric field strength;
  - B. For ions with similar size in electrophoresis, their mobilities decrease with charges;
  - C. Electric double layer created by negatively charged silica surface and nearby cations;
  - D. For electroosmotic flow (EOF), net EOF toward the cathode when an external field is applied;
  - E. For capillary electrophoresis, the only fundamental source of broadening under ideal conditions is longitudinal diffusion.
12. An organic pollutant contains one bromines (Br) and two chlorine (Cl) in its structure. Estimate the possible ratio of the isotopic patterns on the molecular ion.  
Your answer: A. 9:6:3:1; B. 1:3:3:1; C. 3:7:5:1; D. 9:15:7:1. E. None of the above
13. For **Ion mobility spectrometers (IMS)**, which of the following statement **is true**?
- A. IMS is a form of mass spectrometry;
  - B. Like mass spectrometry, IMS is not capable of separating isomers;
  - C. IMS separates ions according to their size-to-charge ratios;
  - D. IMS can provide structural information of analytes;
  - E.  $\text{Cl}_2$  is the reagent gas for generating cations by chemical ionization in IMS analysis.
14. Under what circumstance would buoyance become a non-negligible factor and should be accounted for when using an analytical balance accurate to  $\pm 0.1$  mg.
- A. Variation of the temperature in the laboratory
  - B. The density of standard weights is  $8.0 \text{ g/cm}^3$  and the density of the object being weighed is  $0.2 \text{ g/cm}^3$
  - C. The density of the object being weighed is  $16 \text{ g/cm}^3$
  - D. Density has little role in buoyance consideration
  - E. None of the above

15. Which of the following statements about the blank analysis is **correct**?
- A. An ideal blank should be free of matrix.
  - B. An ideal blank is a solution containing solvents, reagents and analytes.
  - C. A field blank should never leave the laboratory to avoid contamination.
  - D. The step of blank analysis can be omitted if the sample solution is clear and homogeneous.
  - E. The signal from the blank should be subtracted from that of the sample when determining the concentration of analyte.
16. When the work of detecting systematic errors is required, which of the following practices can be performed? (1) analyzing standard reference materials (SRMs), (2) blank analysis, (3) independent analysis by other reliable methods, (4) compared with other laboratories using the same method, (5) using another instrument of a different maker/ manufacturer.  
Your answer:
- A. 1, 2   B. 1, 2, 3   C. 1, 3, 4   D. 1, 2, 3, 4   E. 1, 4, 5
17. Which of the following statements is **true**?
- A. Systematic errors can be determined and hence largely corrected.
  - B. Calculation of detection limits is a way to demonstrate accuracy.
  - C. Systematic error affects reproducibility and thus accuracy of the analytical results.
  - D. Random errors can be eliminated or improved with a chosen method.
  - E. Random errors can be corrected by calibration with standard reference materials.
18. In order to correct for instrumental drift in analysis and to assure data quality, which of the following practices can be performed?
- A. Standard addition
  - B. External standardization
  - C. Internal standardization
  - D. Spiking with a known amount of the analyte to calculate recovery
  - E. To regularly perform calibration check
19. When considering the propagation of uncertainty with a calibration curve from linear regression, which of the following approaches or conditions does not help narrow down the uncertainty ( $S_x$ ) of the unknown concentration  $[X]$ ?
- A. to achieve a greater slope for the calibration curve
  - B. to have more data points for the calibration line
  - C. to increase the number of replicate measurements of the unknown
  - D. the signal or response of the unknown to be at the far ends of the calibration line
  - E. a correlation coefficient closer to unity

20. Which of the following statements regarding detection limits (D.L.) are false: (1) Only ~1% of measurements of a blank are expected to exceed the D.L. (2) If the analyte concentration is right at the D.L., then one is only 50% confident to say that the sample does contain analyte. (3) If the analyte concentration is right at the D.L., then one is 99% confident to say that the sample does contain analyte. (4) Measurements showing results below D.L. can suggest the sample does not contain analyte. (5) The probability of being false positive is ~1% for samples containing no analyte. Your answer:  
A. 1, 2, 5 B. 1, 2, 4 C. 3, 5 D. 2, 5 E. 3, 4
21. Why is source modulation needed in atomic absorption spectroscopy?  
(1) to create a double-beam configuration for the spectrometer, (2) to separate the emission signal of the analyte in the flame from the emission of the fuel and oxidant in the flame, (3) to create a AC type of signal for the flame emission, (4) to create a DC type of signal for the light source, (5) to create a AC type of signal for the light source. Your answer:  
A. 1, 2, 4 B. 1, 5 C. 1, 4 D. 1, 2, 3 E. 5
22. In the ICP-MS technique which of the following ionization method is utilized?  
A. Electrospray  
B. MALDI  
C. Electron impact  
D. High temperature in an inert atmosphere  
E. Reaction with Ar atoms
23. Which of the following techniques is not correct in producing X-rays?  
A. bombardment of a metal target with a beam of high-energy electrons  
B. use of a radioactive source to excite a metal target  
C. excitation of a metal target through chemical reactions  
D. from a synchrotron radiation source  
E. irradiation of a metal target with a primary X-ray source
24. Why is the graphite furnace AA technique more sensitive than the flame AA technique for most of the transition metals? (1) the sample amount is larger for furnace AA; (2) the average residence time of atoms in furnace is much longer than in the open flame; (3) the steady-state concentration of atoms in the flame is much lower than in the furnace; (4) the flame temperature is higher than furnace's; (5) the detector of furnace AA is more sensitive. Your answer:  
A. 2, 3, 5 B. 2, 3 C. 4, 5 D. 1, 4, 5 E. 3, 4

類組：化學類 科目：分析化學(1005)

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25. The interferometer is used in FT-IR (1) to act like a grating in a monochromator, (2) to scan wavelengths from low to high, (3) to facilitate FT because the IR frequencies are too high to be acquired by average-cost electronics, (4) to resolve IR frequencies into a series of sine and cosine functions, (5) to produce an identical time-domain spectrum of much lower frequencies. Your answer:

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