類組：化學類　科目：分析化學(1005)　　共 4 頁 第 1 頁

一、 單選題，每題4分，答錯不倒扣。

1. The order of the polarity of these four compounds from high to low is A>B>C>D. Predict the elution order of these four compounds (A, B, C. and D) when using reverse high-performance liquid chromatography to separate these four compounds from a sample.
(A) A-B-C-D
(B) D-C-B-A
(C) C-D-A-B
(D) D-A-B-C

2. Predict the possible elution order of these four species (A, B, C, and D) in size exclusion chromatography. The size of these four species is A>B>C>D.
(A) A-B-C-D
(B) D-C-B-A
(C) C-D-A-B
(D) D-A-B-C

3. Select ionization method(s) (electron ionization (EI), chemical ionization (CI), fast atom bombardment (FAB), and electrospray ionization (ESI)) that are suitable for the analysis of analytes with thermal stability and high vapor pressure.
(A) ESI and FAB
(B) ESI and EI
(C) ESI and CI
(D) EI and CI

4. Matrix-assisted laser desorption/ionization mass spectrometry is a suitable tool for the analysis of analytes such as
(A) Peptides
(B) Proteins
(C) Polymers
(D) All of the answers above are correct.

5. Atmospheric pressure chemical ionization (APCI)
(A) APCI is usually used to couple with gas chromatography.
(B) Air is used as the reagent gas in APCI.
(C) Multiply-charged ions are commonly observed in ACPI mass spectra.
(D) All of the statements above are correct.

6. Select the spectroscopy below that its results are affected the most by atomization temperature.
(A) Atomic absorption spectroscopy
(B) Atomic fluorescence spectroscopy
(C) Atomic emission spectroscopy
(D) X-ray absorption spectroscopy

7. Atomic emission spectroscopy (AES)
(A) AES is useful for elemental analysis.
(B) Inductively coupled plasma is a suitable atomization source in AES.

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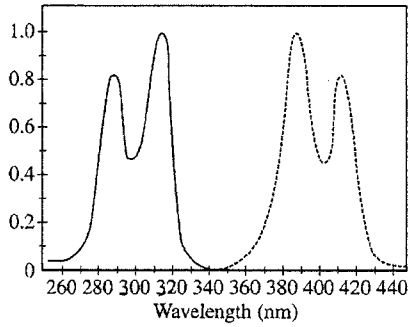
(C) The net charge in inductively coupled plasma is zero.
(D) All of the statements above are correct.

8. Gas chromatography (GC)
(A) The flame ionization detector is very sensitive to molecules containing electronegative functional groups.
(B) The flame ionization detector is very sensitive for organic compounds containing phosphorus and nitrogen.
(C) GC is a good separation tool for compounds with thermal stability and low boiling point.
(D) Oxygen is usually used as the carry gas in GC.

9. Quadrupole mass spectrometer (QMS)
(A) QMS is a high-resolution mass analyzer.
(B) QMS can provide unit mass resolution.
(C) QMS cannot be coupled with gas chromatography.
(D) All of the statements above are correct.

10. In thin layer chromatography, the mobile phase moves through the stationary phase mainly by
(A) capillary action
(B) centrifugation
(C) pressure
(D) friction force

二、多選題，ABCDE每一選項單獨計分，每題5分，答錯不倒扣。



11. Which descriptions are correct for a conventional organic dye with spectra shown above?
(A) The right (dashed line) and left (solid line) spectra represent the absorption and emission profile, respectively.
(B) The maximal fluorescence intensity can be obtained by exciting the dye at 290 nm.
(C) The maximal fluorescence intensity can be obtained by using a emission longpass filter with a cut-on wavelength at 350 nm.
(D) The cross-talk in emission is not an issue for this dye.
(E) The fluorescence quantum yield can be determined based on the informtaion provided above.

12. Two students calibrated their 10 mL pipets and obtained the data shown below. Which of the following

statements about these data is true?

Measurement	Pipet X	Pipet Y
1	10.25 mL	9.70 mL
2	9.65 mL	9.69 mL
3	10.10 mL	9.73 mL
4	10.40 mL	9.68 mL
Mean	10.0 mL	9.70 mL
Standard Deviation	0.36	0.02

(A) Student X has evidence of a significant indeterminate (random) error.
(B) Student X can use the value of 10.00 mL as the volume of pipet X without introducing any significant error (less than 4 parts per thousand) in an analysis
(C) Student Y has evidence of a significant indeterminate (random) error.
(D) Student Y can use pipet Y without correction, because the standard deviation is so small.
(E) Student Y can use the value of 9.70 mL as the volume of pipet Y without introducing any significant error (less than 4 parts per thousand) in an analysis.

13. During acid-base titration, the operator cannot detect the indicator color of the solution at the end point easily. This might cause what type(s) of the following error(s)?
(A) Random error.
(B) Systematic error.
(C) Gross error.
(D) Instrumental error.
(E) Environment error.

14. Which of the following statements are correct??
(A) Sensitivity refers to the true positive rate among the infected population
(B) The definition of sensitivity is to discriminate the concentration of interference from other species
(C) The higher the specificity, the lower the false positive rate
(D) The lower the sensitivity, the higher the false negative rate
(E) In an area with a lower infected population, the false positive rate is always an issue

15. Which of the following statements are incorrect?
(A) The limit of detection is the analyte concentration that is required to produce a signal greater than three times the standard deviation of the noise level
(B) The detection limit is regarded as the lowest concentration which is measured in the experiment
(C) The linear range is defined as the response changes when the analyte concentration is changed even the relationship may be non-linear
(D) The employment of external standard method can efficiently prevent from the matrix interference
(E) The standard addition method relies on the spiking several sets of standard samples with unknown concentrations into the analyte

16. Which of the followings are correct concerning the spectroscopy?
(A) NMR spectroscopy has much lower selectivity but higher sensitivity as compared to UV spectroscopy
(B) In a gas sample at room temperature, there are greatest number of molecules occupying in the higher rotational energy states other than the lowest rotational energy state
(C) Vibrational energy type has evenly spaced energy levels
(D) UV absorbance can be used to quantitatively determine the concentration of molecules
(E) The peaking spacing in rotational spectrum can be used to calculate the bond length of the molecule

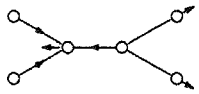
17. Analysis of a bottle of 100 mg vitamin C tablets yields an average vitamin C content of 99.8 mg, with a standard deviation of ±0.3 mg. Assuming Gaussian statistics, which of the followings are NOT true:
(A) None of the tablets contains less than 99.5 mg of vitamin C
(B) 68% of the tablets contain between 99.5 and 100.1 mg of vitamin C

(C) 97% of the tablets contain between 99.5 and 100.1 mg of vitamin C
(D) All of the tablets contain less than 100 mg of vitamin C
(E) The average value is reasonable

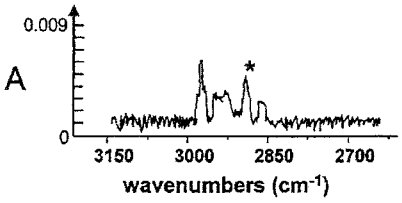
18. Which of following could be the primary standard for use in standardizing bases
(A) Potassium hydrogen iodate
(B) Sulfuric acid
(C) Acetic acid
(D) Potassium hydrogen phthalate
(E) Silver nitrate

19. Excess silver nitrate is added to a known volume of a solution containing only sodium chloride and potassium bromide. To determine the composition of the original solution, it is necessary and sufficient to know the
(A) Total weight of the solute in the original solution
(B) Weight of the precipitate
(C) Molarity of the silver nitrate solution used
(D) Density of the original solution at a specified temperature
(E) Density and the specific conductance of the original solution

20. A buffer is made from a weak acid and its conjugate base where the concentration of the weak acid is twice that of its conjugate base. Doubling the concentration of the conjugate base by adding more conjugate base salt will have what effect on its pH
(A) It has no effect
(B) It significantly decreases the pH
(C) It slightly increases the pH
(D) It changes the pH asymptotically to the pK_a of the acid
(E) It changes the pH asymptotically to the pK_b of the conjugate base

21. Which of the followings are correct about the spectroscopy?
(A)  This mode is active in infrared spectroscopy
(B) The signal of Surface-enhanced Raman spectroscopy is related to electromagnetic field of substrates
(C) Rayleigh scattering produces lower signal than Raman scattering upon electromagnetic radiation
(D) It is possible for the overlap/interference between fluorescence and Raman signals
(E) $N_2(g)$ exhibits obvious rotational spectra

22. The spectrum below was collected with an FTIR using a liquid nitrogen cooled HgCdTe (MCT) detector based on 25 scans. Which of the followings are correct for the marked peak (*).
(A) The noise level is ~3.54 x10^{-4}
(B) S/N ratio for the peak is ~113
(C) 2500 measurements are needed to improve the S/N ratio by a factor of 10.
(D) S/N can be highly improved if liquid nitrogen is not added for the detector
(E) Water interference is not an issue within this observation window



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