

# 國立成功大學

## 113學年度碩士班招生考試試題

編 號： 47

系 所： 化學系

科 目： 分析化學

日 期： 0202

節 次： 第 4 節

備 註： 不可使用計算機

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

**I. Multiple choice questions (Each question has one answer.). 5 pts for each question.**

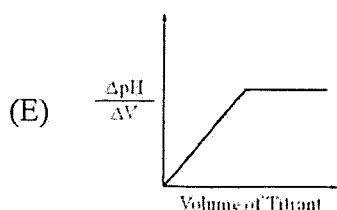
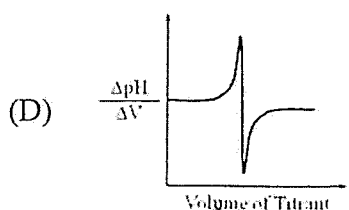
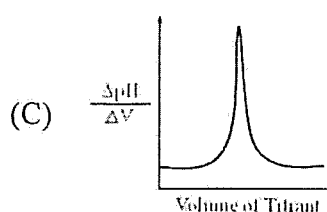
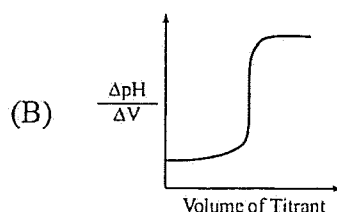
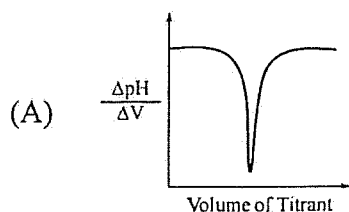
1. Which of the following statements is **incorrect**?

- (A) Quantitative analysis methods are traditionally classified as gravimetric methods, volumetric methods, or instrumental methods.
- (B) A semimicro analysis is performed on samples in the range of 0.01 to 0.1 g, and samples for micro analysis are in the range of  $10^{-3}$  to  $10^{-5}$  g.
- (C) Species present in amounts between 100 ppm (0.01%) and 1 ppb are called trace constituents, and those present in amounts lower than 1 ppb are usually considered to be ultratrace constituents.
- (D) The analytical sample must be processed in dependable manner that maintains sample integrity without losing sample or introducing contaminants.
- (E) The analysis of real samples is complicated by the presence of the sample matrix that contains species with chemical properties similar to the analyte.

2. Which of the following statements is **incorrect**?

- (A) Titration methods are based on determining the quantity of a reagent of known concentration that is required to react completely with the analyte.
- (B) A standard solution or a standard titrant is a reagent of known concentration that is used to carry out a volumetric titration.
- (C) Coulometric titrations involve measuring the volume of a solution of known concentration that is needed to react completely with the analyte.
- (D) It is sometimes necessary to add an excess of the standard titrant and then determine the excess amount by back-titration with a second standard titrant.
- (E) Indicators are often added to the analyte solution to produce an observable physical change at or near the equivalence point.

3. In plotting data from the titration of a strong acid with a strong, a plot of the change in pH per change in volume of titrant ( $\Delta\text{pH}/\Delta V$ ) versus volume of titrant will have which of the following shapes?



4. Which of the instrument analysis is **incorrect**?

- (A) Atomic Force Microscopy (AFM)
- (B) Surface-assisted Laser Desorption/Ionization (SALDI)
- (C) Electron Spectroscopy for Chemical Analysis (ESCA)
- (D) Brunauer-Emmett-Teller analysis (BET)
- (E) Scattering-angle X-ray Spectroscopy (SAXS)

5. The ionic strength of a solution depends on which of the following?

- I. The size of ions
- II. The charges on ions
- III. The concentration of the ions
- IV. The ratio of charge to concentration

- (A) I and II only
- (B) I and III only
- (C) I, II and III only
- (D) II and III only
- (E) II and IV only

6. Which of the following optics used in optical spectrometer is similar to the mass analyzer?

- (A) Monochromator
- (B) Nebulizers
- (C) Laser
- (D) Sample injector
- (E) Photomultiplier tube

7. The table below contains potential readings near the equivalence point of a potentiometric titration. What is the volume of titrant needed to reach the equivalence point?

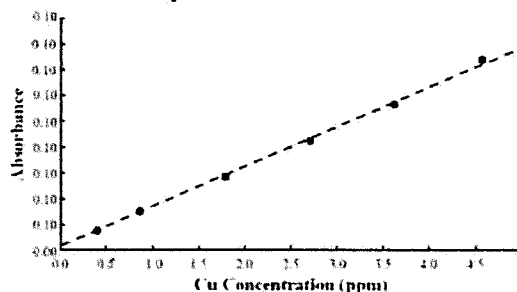
<u>Volume of Titrant (mL)</u>	<u>Potential (mV)</u>	<u>Potential Change per 0.1 mL Volume Change</u>
24.70	210	12
24.80	222	18
24.90	240	120
25.00	360	240
25.10	600	16
25.20	616	9
25.30	625	

- (A) 24.96 mL
- (B) 25.00 mL
- (C) 25.04 mL
- (D) 25.14 mL
- (E) 25.50 mL

8. A quartz crystal microbalance (QCM) measures a mass variation per unit area by measuring the change in frequency of a quartz crystal resonator/oscillator. Which is the following effect the basis of a quartz crystal resonator/oscillator?

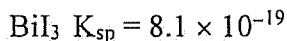
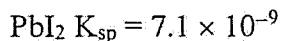
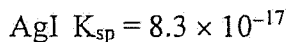
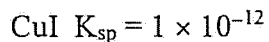
- (A) Magnetic effect
- (B) Ultrasonic effect
- (C) Piezoelectric effect
- (D) Photoelectric effect
- (E) Matrix effect

9. A working curve for the analysis of standard solutions of copper using atomic absorption spectrophotometry is shown below. What is the curve most likely used to determine?

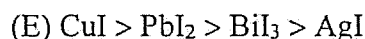
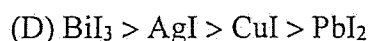
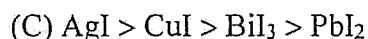
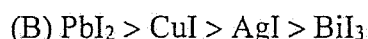
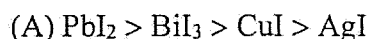


- (A) The copper concentration in the standard
  - (B) The copper concentration in the unknown solutions
  - (C) The absorbance in each standard solution
  - (D) The wavelength response of the detector
  - (E) The intensity of light source
10. Which of the following substances is used in Gas-solid chromatography separation?
- (A) Thermally stable organic components
  - (B) Volatile organic components
  - (C) Thermally stable inorganic components
  - (D) Low molecular weight gaseous species
  - (E) Volatile high molecular weight polymers
11. Which of the following statements is **correct**?
- (A) In volatilization gravimetry, the analyte is separated from other constituents of a sample by converting it to a precipitate of known chemical composition.
  - (B) In precipitation gravimetry, the product should be of sufficiently low solubility and reactive with constituents of the atmosphere.
  - (C) A colloid consists of solid particles from  $10^{-2}$  to  $10^{-6}$  m in diameter that are visible to the naked eyes.
  - (D) Nucleation is a process in which a maximum number of atoms, ions, or molecules join together to give a small number of larger particles.
  - (E) When a precipitate is formed at high relative supersaturation, nucleation is the major precipitation mechanism.

12. The solubility products for a series of iodides are the following:



While those four iodide compounds dissolve in a 0.020 M solution of the solute cation, what is the order of decreasing molar solubility?

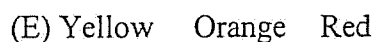
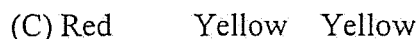
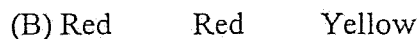
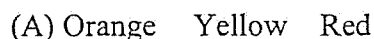


13. Cresol red indicator has two color changes in the pH range 0 to 14. The following table is the information of cresol red indicator.

pH Range	Acid Color	Base Color
0.2 – 1.8	Red	Yellow
7.2 – 8.8	Yellow	Red

What colors are to be expected in solutions at pH values of 1.0, 6.0, and 9.0, respectively?

pH: 1.0          6.0          9.0



14. Which of the following is **not** an advantage of Syringe type pumps used in HPLC?

(A) Independent of viscosity

(B) Pulse-less flow

(C) High pressure capability

(D) Unlimited solvent capacity

(E) Accuracy and precision

15. A 0.012 mole sample of  $\text{Na}_2\text{SO}_4$  is added to 400 mL of each of two solutions. One solution contains  $1.5 \times 10^{-3}$  M  $\text{BaCl}_2$  ( $K_{sp} : 1.5 \times 10^{-9}$ ); the other contains  $1.5 \times 10^{-3}$  M  $\text{CaCl}_2$  ( $K_{sp} : 6.1 \times 10^{-5}$ ). Which of the following statements is **correct**?

(A)  $\text{CaSO}_4$  would precipitate but  $\text{BaSO}_4$  would not.

(B)  $\text{BaSO}_4$  would precipitate but  $\text{CaSO}_4$  would not.

(C) Both  $\text{BaSO}_4$  and  $\text{CaSO}_4$  would precipitate.

(D) Neither  $\text{BaSO}_4$  nor  $\text{CaSO}_4$  would precipitate.

(E) Not enough information is given to determine whether precipitation would occur.

16. Which of the following filter is used in tandem mass spectrometer?

- (A) Low energy filter
- (B) High energy filter
- (C) Quadrupole mass filter
- (D) Time of flight mass filter
- (E) None of them

**II. Problem-solving and short answer questions. Show all work, steps, calculation, units and explanation if applicable. 10 pts for each question.**

1. Please list the main differences between Infrared spectroscopy and Raman spectroscopy.
2. Please describe the theory of band broadening in chromatography.