

科目：分析化學

適用：應化系

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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Questions 1-25 ($3\% \times 25 = 75\%$): choose the appropriate answer A, B, C or DQuestion 26: $2\% \times 5 = 10\%$ Question 27: $5\% \times 3 = 15\%$

1. Which chemical can be used as a primary standard in analytical chemistry?
 - A. Sodium hydroxide
 - B. Ferrous chloride
 - C. Potassium permanganate
 - D. Silver nitrate
2. Which glassware is used for extraction procedures in analytical experiments?
 - A. Graduated cylinder
 - B. Rounded-bottomed flask
 - C. Separating funnel
 - D. Burette
3. A solution was prepared by mixing 0.1 mole of K_2SO_4 and 0.05 mole of $Ba(NO_3)_2$ and dissolving in sufficient water to give 1000 mL. The solution is
 - A. 0.05 M in nitrate anion
 - B. 0.1 M in sulfate anion
 - C. 0.1 M in potassium cation
 - D. 0.1 M in barium cation
4. The precision of a set of replicate data can be described by
 - A. standard deviation
 - B. absolute error
 - C. average
 - D. coefficient of determination
5. Sources of random uncertainties in the calibration of a pipet does not include
 - A. contaminants on the inner surfaces of the pipet
 - B. variation in the angle of the pipet as it drains
 - C. temperature fluctuations
 - D. the level of the water with respect to the marking on the pipet
6. Acid rain usually causes a low pH value in ground water and lakes, while some area shows high susceptibility of natural water to acidification because of the existence of a chemical with buffer capacity. The chemical could be
 - A. lead sulfide
 - B. calcium carbonate
 - C. manganese chloride

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D. aluminum oxide

7. Debye-Hückel equation permits the calculation of a property of ions. The property is
- A. effective diameter
 - B. ionic strength
 - C. activity coefficient
 - D. electric potential
8. During precipitate formation, a portion of solution may co-precipitate as contaminant. The process is called
- A. surface adsorption
 - B. mixed-crystal formation
 - C. occlusion
 - D. mechanical entrapment
9. Which statement is correct associated with acid-base titration?
- A. The end-point pH change in the titration of 0.01 M acetic acid is smaller than that in 0.1 M acetic acid using the same standard base solution.
 - B. There will be 2 end points in the titration of 0.05 M H_2SO_4 using a standard base solution.
 - C. There will be 3 end points in the titration of 0.1 M H_3PO_4 using a standard base solution.
 - D. For the titration of 0.05 M NaCN with 0.1 M HCl, the end point locates at base region.
10. Kjeldahl method is applied for determining organic
- A. sulfur
 - B. nitrogen
 - C. phosphine
 - D. chloride
11. Which one of the following statement is incorrect for ethylenediaminetetraacetic acid (EDTA)?
- A. EDTA has four acid dissociation constants
 - B. EDTA is a tetradentate for most metal cations
 - C. EDTA forms 1:1 complex with calcium (II)
 - D. There are five species when EDTA dissolves in pH 4 solution.
12. Which one of the following is a visible photon?
- A. 6×10^{14} Hz
 - B. 250 nm
 - C. 100 cm^{-1}
 - D. $2 \times 10^8 \text{ J/mol}$
13. The common detectors for absorption spectroscopy do not include
- A. silicon photodiodes

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- B. bolometers
- C. monochromator
- D. photomultiplier tube

14. The most useful radiation sources for atomic absorption spectroscopy do not include

- A. hollow-cathode lamp
- B. electrodeless-discharge lamp
- C. Hg lamp
- D. D₂ lamp

15. Separation of biochemical mixtures can be achieved by the use of

- A. ion-exchange chromatography
- B. gas-liquid chromatography
- C. affinity chromatography
- D. size-exclusion chromatography

16. The measurement of solution pH values by the use of pH electrode is based on theory of

- A. potentiometry
- B. amperometry
- C. coulometry
- D. conductometry

17. Considering the chemical reaction for a piece of copper immersed in a solution of 0.02 M silver nitrate. Which one of the following statement is incorrect?

- A. The copper acts as a chemical reductant
- B. The silver is reduced as solid particles
- C. The dissolved oxygen oxidizes the silver nitrate
- D. The solution changed color after reaction.

18. Which statement is correct for a photometric titration of iron(III) with thiocyanate ion (SCN⁻)?

- A. The reaction product (Fe³⁺:SCN⁻) is a 1:3 complex
- B. The complex product is yellow color
- C. A interferometer is used with a photometer
- D. The product is a charge-transfer complex

19. Which statement is correct for molecular fluorescence (FL)?

- A. An increase in temperature leads to increased FL efficiency
- B. An increase in solvent viscosity leads to increased FL efficiency
- C. The quantum yield of highly fluorescent molecules is larger than unity
- D. FL bands usually locate in the bands of absorbed radiation

20. The mass spectrum of ethyl benzene usually presents a molecular ion peak (parent peak) of

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- A. 89
- B. 91
- C. 103
- D. 106

21. Select the incorrect quantities of the following.

- A. $3.2 \times 10^8 \text{ nm} = 0.32 \text{ m}$
- B. $6.3 \times 10^9 \text{ } \mu\text{mol} = 63 \text{ mol}$
- C. $45000 \text{ g} = 45 \text{ kg}$
- D. $1.8 \times 10^8 \text{ Hz} = 180 \text{ MHz}$

22. Which salt has the smallest metal cation concentration when dissolves in water?

- A. CaSO_4 ($K_{sp} = 2.4 \times 10^{-5}$)
- B. $\text{Ag}_2\text{C}_2\text{O}_4$ ($K_{sp} = 3.5 \times 10^{-11}$)
- C. $\text{Zn}(\text{OH})_2$ ($K_{sp} = 3.0 \times 10^{-16}$)
- D. AgBr ($K_{sp} = 5.0 \times 10^{-13}$)

23. The standard electrode potential of $\text{Fe}^{3+/2+}$, $\text{Ag}^{+/0}$, Ag/AgCl is 0.771 V, 0.799 V and 0.222V, respectively, with respect to standard hydrogen electrode. The standard electrode potential of $\text{Fe}^{3+/2+}$ can also be shown as

- A. 0.028 V vs. $\text{Ag}^{+/0}$
- B. 1.570 V vs. $\text{Ag}^{+/0}$
- C. 0.549 V vs. Ag/AgCl
- D. 0.993 V vs. Ag/AgCl

24. Which one of the following acid can be used to prepare a pH 7.0 buffer solution with addition of NaOH solution?

- A. H_3PO_4 ($K_a = 7.11 \times 10^{-3}$, 6.32×10^{-8} , 4.5×10^{-13})
- B. $\text{HOOCCH}_2\text{COOH}$ ($K_a = 1.42 \times 10^{-3}$, 2.01×10^{-6})
- C. H_3BO_3 ($K_a = 5.81 \times 10^{-10}$)
- D. CH_3COOH ($K_a = 1.75 \times 10^{-5}$)

25. Which statement is correct for the ion-exchange resins?

- A. Strong base type exchanger usually contains quaternary amine groups
- B. Base type exchanger is used to retains metal cations
- C. Polyvalent ions are equally retained as singly charged species
- D. Ion-exchange resins are not useful for separation of organic ionic species

26. List 3 systematic errors and 2 random errors that commonly present in weighing a solid powder with an analytical balance. ($2\% \times 5 = 10\%$)

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27. A 25.0 mL Al^{3+} was titrated with an appropriate excess of aqueous solution of NaQ (sodium salt of 2-quinizarinsulfonic acid). The reaction product exhibits an absorption peak at 560 nm, and the theoretical molar absorptivity is $14000 \text{ L cm}^{-1} \text{ mol}^{-1}$. (5% x 3 = 15%)
- A. What is the absorbance of a $2.5 \times 10^{-5} \text{ M}$ of the reaction product in a 1.00 cm cell?
 - B. How to apply photometric method to find the formula of the complex product?
 - C. What is the relation between absorbance (A) and transmittance (T)?

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