

國立暨南國際大學九十二學年度碩士班研究生入學考試試題

第 1 節分析化學 適用：(應化所 442)

(本試題共 3 頁，第 / 頁)

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，並限以藍黑色筆作答。

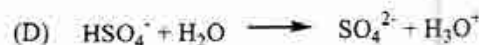
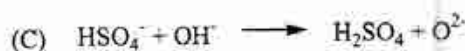
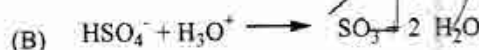
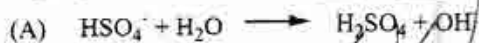
3. 試題隨卷繳回。(餘詳詳閱試場規則)

***Electronic calculator is not allowed during the test.

***For problem number 1 to 20, choose the most proper answer (60 points).

***For problem number 21, 22 and 23, they are assigned as 15, 15, 10 points, individually.

1. The bisulfate ion HSO_4^- can act as either an acid or a base in water solution. In which of the following equations does HSO_4^- act as an acid?



(E) none of these

2. Which of the following 0.01 N solution has the highest pH? Given the acid dissociation constant of HOAc is 1.8×10^{-5} , and those of H_2CO_3 are 4.3×10^{-7} and 5.6×10^{-11} . (A) Na_2CO_3 (B) NaHCO_3 (C) NaOAc (D) HOAc (E) H_2CO_3

3. Which of the following compounds has the lowest solubility in mol/L in water at 25°C ? (A) Ag_3PO_4 ($K_{sp} = 1.8 \times 10^{-18}$) (B) $\text{Sn}(\text{OH})_2$ ($K_{sp} = 5.0 \times 10^{-26}$) (C) CdS ($K_{sp} = 3.6 \times 10^{-29}$) (D) CaSO_4 ($K_{sp} = 6.1 \times 10^{-5}$) (E) $\text{Al}(\text{OH})_3$ ($K_{sp} = 2.0 \times 10^{-33}$)

4. When the equation for the following reaction is balanced, what is the sum of the coefficients?



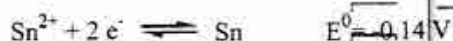
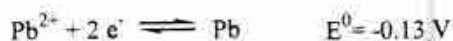
(A) 20 (B) 22 (C) 24 (D) 26 (E) none of the above is true

5. How many electrons are transferred in the above reaction?

(A) 1 (B) 2 (C) 4 (D) 5 (E) 6

6. Which of the following species cannot function as an oxidizing agent? (A) I^- (B) S (C) $\text{Cr}_2\text{O}_7^{2-}$ (D) NO_3^- (E) MnO_2

7. A cell consists of a left compartment with a tin electrode in contact with 0.1 M $\text{Sn}(\text{NO}_3)_2(\text{aq})$ and a right compartment with a lead electrode in contact with 1.0 mM $\text{Pb}(\text{NO}_3)_2(\text{aq})$. The electrode potentials are



When this cell is allowed to discharge spontaneous at 25°C , which of the following statement is true? (A) Electrons will flow from left to right through the circuit. (B) Pb^{2+} will be reduced to Pb metal. (C) The concentration of Sn^{2+} ions in the left compartment will increase. (D) No noticeable change will occur because the cell is at equilibrium. (E) It is a galvanic cell.

8. Calculate the potential for the above cell. (A) -0.39 V (B) -0.05 V (C) 0.00 V (D) +0.05 V (E) +0.39 V

9. Chromatography is divided into several categories based on the mechanism of interaction between analyte and the stationary phase. Which description of the following is wrong? (A) The stationary phase in molecular exclusion chromatography is a porous gel. (B) The divalent cations can be

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- separated by an anion exchanger. (C) Proteins can be separated by affinity chromatography. (D) In adsorption chromatography, analyte species are adsorbed onto the surface of a polar packing. (E) In reverse phase chromatography, the least polar analyte is eluted last.
10. When a molecule in the excited state returned to its ground state, the energy may be released by a radiation process called (A) internal conversion (B) intersystem crossing (C) vibrational relaxation (D) absorption (E) fluorescence
11. After the components of a gas mixture are separated in the chromatographic column, which detector of the following is the most common and economic? (A) thermal conductivity (B) mass spectrometric (C) absorbance (D) conductivity (E) electron capture detector.
12. For a separation of a mixture containing hexane (I), n-hexanol (II) and benzene (III) through a C-18 column, predict the order of the elution. (A) (I) > (II) > (III) (B) (I) > (III) > (II) (C) (II) > (III) > (I) (D) (II) > (A) > (III) (IV) (III) > (II) > (I)
13. The electrochemical technique that uses a periodic, triangular waveform is called (A) cyclic voltammetry (B) linear scan voltammetry (C) differential pulse polarography (D) square wave polarography (E) stripping analysis
14. When we conduct electrogravimetric analysis of a copper salt through the following reaction, $\text{Cu}^{2+} + 2 \text{Ag} \longrightarrow \text{Cu} + 2 \text{Ag}^+$, which statement is wrong? (A) The copper was deposited at the cathode (B) The input electrolysis voltage must be increased by the effect of ohmic potential (C) mechanical stirring will decrease the effect of concentration polarization (D) the electron will flow from the anode to the positive terminal of battery (E) all the statements are wrong.
15. The description of the statistic concept to deal with the measurements is listed, which statement is wrong? (A) Random error arises from the effects of uncontrolled variables in the measurement. (B) Accuracy describes the reproducibility of a result. (C) The smaller the standard deviation, the more closely the data are clustered about the mean. (D) The method of least squares is the most widely used technique to find the best straight line. (E) The Q test helps us to decide whether or not a questionable datum should be discarded.
16. Which statement about activity and activity coefficient is wrong? (A) The activity is the product of the concentration and the activity coefficient. (B) For ionic species, the activity is related to the ionic strength of the solution. (C) The activity coefficients of ions of the same charge are approximately equal. (D) In solutions that are not too concentrated, the activity coefficient of a given species is dependent of the nature of the electrolyte. (E) In very diluted solutions, the activity coefficient is unity.
17. Which statement about buffer is wrong? (A) A buffered solution resists changes in pH when acids or bases are added. (B) Buffer solution containing acetic acid and sodium acetate is suitable for EDTA titration of Ca^{2+} in water. (C) A buffer solution is formed when conducting a weak acid / strong base titration. (D) Dilution does not affect the pH of the buffer solution significantly. (E) When equal amount of weak acid and its conjugated base are mixed together, the pH of the solution is equal to pKa, where Ka is the acid dissociation constant of the weak acid.
18. Which statement about the iodine titration is wrong? (A) Iodine is a mild oxidant. (B) Triiodide ion is a mild reductant and is used as a titrant in iodine titration. (C) Iodimetry involves titration with iodine. (D) Starch is a good indicator for iodine titration and should be freshly prepared. (E) Iodine can be standardized with thiosulfate solution.

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19. Light striking a sample can be (A) transmitted (B) absorbed (C) reflected (D) scattered (E) all of them.
20. Spectroscopic instrument are made up of several components. Which statement of the following is wrong? (A) The tungsten-filament lamps is the most common source of visible and near-infrared radiation (B) Monochromators are used for wavelength selection (C) The photomultiplier tube is a device to accept photons and generate a large number of electrons. (D) The single-beam instrument makes continuous measurements of the light emerging from the sample and the reference cells. (E) The UV/Vis absorption spectrum can be monitored simultaneously by a diode-array detector.
21. Ethylenediaminetetraacetic acid, which is commonly shortened to EDTA or H_4Y , is the most widely used complexometric titrant. (1) Draw the chemical structure for H_4Y (3 points). (2) Write a chemical reaction for formation complexes of EDTA and Al^{3+} (3 points). (3) What is the formation constant expression for the reaction? (3 points) (4) α_4 is the fraction of EDTA in the form Y^{4-} , and C_T is total molar concentration of uncomplexed EDTA ($C_T = [H_4Y] + [H_3Y^-] + [H_2Y^{2-}] + [HY^{3-}] + [Y^{4-}]$). Show that

$$\alpha_4 = \frac{K_1 K_2 K_3 K_4}{[H^+]^4 + K_1[H^+]^3 + K_1 K_2[H^+]^2 + K_1 K_2 K_3[H^+] + K_1 K_2 K_3 K_4}$$

where K_1, K_2, K_3, K_4 are the four acid dissociation constants for H_4Y (6%).

22. A 50.00 mL aliquot of 0.05 M NaCN is titrated with 0.100 M HCl. Calculate the $[H^+]$ after the addition of (a) 5.00 (b) 25.00 (c) 25.5 mL of acid. The acid dissociation constant for HCN is 6.2×10^{-10} (15 points).

23. Explain the following terms with an example, respectively (a) internal standard (b) primary standard (10 points).

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