高雄醫學大學 113 學年度學生轉系考試【普通化學】試題

說明：一、請一律以「答案卷」作答，作答時不得使用鉛筆，違者該科答案卷不予計分；限用黑色或藍色墨水的筆書寫。
二、考生應在答案卷上規定範圍內作答，且不得書寫任何與答案無關之文字、符號，違者該科不予計分。
三、答案卷以每人一張為限，不得要求增補；試題與答案卷必須繳回，不得攜出試場。

*可使用工程型計算機

1. Which of the following combinations of quantum numbers are not allowed?

I. n= 3, l= 3, m_l= 0, m_s= -1/2
II. n= 4, l= 3, m_l= 2, m_s= -1/2
III. n= 4, l= 1, m_l= -1, m_s= +1/2
IV. n= 5, l= -4, m_l= 2, m_s= +1/2

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

2. Consider the following orderings.

I. F＜Si＜Ba II. S＜Te＜Se III. Be＜Na＜Rb IV. O＜Fe＜P

Which of these give the correct trend in order of increasing size?

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

3. Calculate the equilibrium molar concentration of Cl_3CCOOH in an aqueous solution that contains 285 mg of trichloroacetic acid, Cl_3CCOOH, in 10.0 mL (the acid is 65% ionized in water).

(A) 0.174 M (B) 61.04 M (C) 0.113 M (D) 0.061 M (E) 113.4 M

4. Ascorbic acid, or vitamin C ($C_6H_8O_6$), is an essential vitamin. Vitamin C tablets are taken as a dietary supplement. If a typical tablet contains 500.0 mg vitamin C, what number of vitamin C molecules is in eight tablets?

(A) 1.37×10^{22} (B) 3.17×10^{25} (C) 1.71×10^{24} (D) 1.71×10^{21} (E) 2.84×10^{23} molecules

5. A solution is prepared by dissolving 10.8 g ammonium sulfate in enough water to make 100.0 mL of stock solution. A 10.00 mL sample of this stock solution is added to 50.00 mL of water. Calculate the concentration of ammonium ions in the final solution.

(A) 0.136 M (B) 0.272 M (C) 0.818 M (D) 0.163 M (E) 0.327 M

6. How many electrons in an atom can have the quantum numbers n = 5, m_l = +1?

(A) 2 (B) 6 (C) 8 (D) 10 (E) 18

7. An unknown diatomic gas has a density of 3.164 g/L at STP. What is the identity of the gas?

(A) $O_{2(g)}$ (B) $Br_{2(g)}$ (C) $F_{2(g)}$ (D) $N_{2(g)}$ (E) $Cl_{2(g)}$

8. Calculate the molar concentration of perchloric acid in a solution that has a specific gravity of 1.67 and is 71% perchloric acid (w/w).

(A) 18.1 M (B) 11.8 M (C) 22.6 M (D) 17.3 M (E) 14.0 M

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9. Consider the titration of 100.0 mL of 0.100 *M* $C_2H_5NH_2$ ($K_b = 5.6 \times 10^{-4}$) by 0.200 *M* HCl at 25.0°C.
Calculate the pH of the resulting solution after the 25.0mL of 0.200 *M* HCl has been added.

(A) pH=1.83 (B) pH=3.25 (C) pH=8.24 (D) pH=12.17 (E) pH=10.75

10. A chemist needs a solution buffered at pH 5.0 and can choose from the following acids (and their sodium salts):

a. propanoic acid $K_a = 1.3\times10^{-5}$
b. chloroacetic acid $K_a = 1.35\times10^{-3}$
c. benzoic acid $K_a = 6.4\times10^{-5}$
d. hypochlorous acid $K_a = 3.5\times10^{-8}$
e. salicylic acid $K_a = 1.06\times10^{-3}$

Which system will work best?

(A) propanoic acid
(B) chloroacetic acid
(C) benzoic acid
(D) hypochlorous acid
(E) salicylic acid

11. In the Lewis structure for xenon dichloride, how many lone pairs of electrons are around the central xenon atom?

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

12. Calculate the root mean square velocity of CH_4 (g) molecule at 546K.

(A) 29.2 m/s (B) 922.6 m/s (C) 91.7 m/s (D) 2.9 m/s (E) 532.7 m/s

13. Calculate the pH of a 0.05 *M* NaCN solution. The pK_a value for HCN is 9.2 .

(A) pH=5.25 (B) pH=3.05 (C) pH=11.83 (D) pH=10.95 (E) pH=8.75

14. A solution is prepared by mixing 100.0 mL of 1.00×10^{-2} *M* magnesium nitrate and 200.0 mL of 1.00×10^{-1} *M* sodium fluoride. Calculate the concentration of magnesium ion at equilibrium with solid magnesium fluoride ($K_{sp} = 6.4 \times 10^{-9}$).

(A) 1.8×10^{-6} M (B) 5.4×10^{-7} M (C) 9.2×10^{-7} M (D) 4.7×10^{-6} M (E) 6.3×10^{-10} M

15. Which of the following sets of molecular structure are incorrect?

I. selenium trioxide: T-shaped structure
II. silicon tetrafluoride: tetrahedral structure
III. xenon tetrafluoride: tetrahedral structure
IV. arsenic pentachloride: trigonal bipyramidal structure
V. nitrite ion: V-shaped structure

(A) III, V (B) II, III, V (C) I, II, III,V (D) I, III (E) I, IV, V

16. A 1.37 *M* solution of citric acid ($H_3C_6H_5O_7$) in water has a density of 1.10 g/cm^3. Calculate the mole fraction of the citric acid. Citric acid has three acidic protons.

(A) 0.056 (B) 0.0035 (C) 0.084 (D) 0.0093 (E) 0.028

17. A 30.00-mL of a mixture that is 0.1500 *M* in hydrochloric acid and 0.0500 M in nitrous acid ($K_a = 4.0\times10^{-4}$) is titrated with 0.1000 *M* sodium hydroxide. Calculate the pH of the resulting solution after the 8.00 mL of 0.1000 *M* sodium hydroxide has been added.

(A) 1.01 (B) 2.10 (C) 3.45 (D) 4.39 (E) 8.33

18. What volume of 2.0 *M* sodium hydroxide must be added to 200.0 mL of 1.00 *M* glycolic acid to produce a buffer solution having a pH of 4.00? (pKa for glycolic acid is 3.83)

(A) 67.6 mL (B) 148 mL (C) 59.7 mL (D) 78.6 mL (E) 83.3 mL

19. When 1.00 L of 1.00 M barium nitrate solution at 25.0°C is mixed with 1.00 L of 1.00 M sodium sulfate solution at 25.0°C in a calorimeter, the white solid barium sulfate forms, and the temperature of the mixture increases to 32.1°C. Assuming that the calorimeter absorbs only a negligible quantity of heat, the specific heat capacity of the solution is 4.18 J/°C · g, and the density of the final solution is 1.0 g/mL, calculate the enthalpy change per mole of barium sulfate formed.

(A) 59 KJ/mol (B) -59 KJ/mol (C) 30 KJ/mol (D) -30 KJ/mol (E) 89 KJ/mol

20. Which of the following statements are incorrect?

I. The hybridization of boron in boron trifluoride is sp^2.
II. The molecule iodine trifluoride is nonpolar.
III. The bond order of disulfur is three.
IV. The molecule hydrogen cyanide has two pi bonds and two sigma bonds.
V. The magnetism of P_2 is paramagnetic.

(A) I, II, III, V (B) I, III (C) III,V (D) I, IV (E) II, III, V