

國立屏東教育大學 101 學年度研究所碩士班入學考試

化學 試題

(化學生物系碩士班)

※請注意：1.本試題共六頁。

2.答案須寫在答案卷上，否則不予計分。

一、選擇題 (每題 3 分，共 78 分)

1. In the coordination compound $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$, the coordination number and oxidation number of the central atom are, respectively:
(A) 2,0 (B) 4,4 (C) 5,0 (D) 4,+2 (E) 6,+2
2. Given the following notation for an electrochemical cell:
 $\text{Pt(s)}|\text{H}_2(\text{g})|\text{H}^+(\text{aq})||\text{Ag}^+(\text{aq})|\text{Ag(s)}$
What is the balanced overall (net) cell reaction?
(A) $2\text{H}^+(\text{aq}) + 2\text{Ag}^+(\text{aq}) \rightarrow \text{H}_2(\text{g}) + 2\text{Ag(s)}$
(B) $\text{H}_2(\text{g}) + 2\text{Ag(s)} \rightarrow \text{H}^+(\text{aq}) + 2\text{Ag}^+(\text{aq})$
(C) $2\text{H}^+(\text{aq}) + 2\text{Ag(s)} \rightarrow \text{H}_2(\text{g}) + 2\text{Ag}^+(\text{aq})$
(D) $\text{H}_2(\text{g}) + \text{Ag}^+(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{Ag(s)}$
(E) $\text{H}_2(\text{g}) + 2\text{Ag}^+(\text{aq}) \rightarrow 2\text{H}^+(\text{aq}) + 2\text{Ag(s)}$
3. A negative sign for ΔG indicates that:
(A) ΔS must be > 0 .
(B) the reaction is spontaneous.
(C) the reaction is fast
(D) the reaction is endothermic.
(E) the reaction is exothermic.
4. Which one of the following combinations cannot be a buffer solution?
(A) HCN and KCN
(B) NH_3 and $(\text{NH}_4)_2\text{SO}_4$
(C) HNO_3 and NaNO_3
(D) HF and NaF
(E) HNO_2 and NaNO_2
5. The pH at the equivalence point of a titration may differ from 7.0 because of:
(A) the initial concentration of the standard solution
(B) the indicator used.
(C) the self-ionization of H_2O .
(D) the initial pH of the unknown
(E) hydrolysis of the salt formed.

6. When comparing acid strength of binary acids HX, as X varies within a particular group of the periodic table, which one of the following factors dominates in affecting the acid strength?
- bond strength
 - electron withdrawing effects
 - percent ionic character of H-X bond
 - solubility
 - Le Chatelier's principle
7. What is the pH of 0.10 M sodium acetate (NaAc) solution? The K_a of acetic acid (HAc) is 1.8×10^{-5} .
- 1.0
 - 0.10
 - 7.0
 - 8.9
 - 5.1
8. Which of the following is true about chemical equilibrium?
- At equilibrium the total concentration of products equals the total concentration of reactants, that is $[\text{products}] = [\text{reactants}]$.
 - Equilibrium is the result of the cessation of all chemical change.
 - There is only one set of equilibrium concentrations that equals the K_c value.
 - The rate constant of the forward reaction is equal to the rate constant for the reverse reaction.
 - At equilibrium the rate of the forward process is the same as the rate of the reverse process.
9. The value of K_p for the reaction of $\text{SO}_2(\text{g})$ with O_2 to produce $\text{SO}_3(\text{g})$ is $3 \times 10^{24} \text{ atm}^{-1}$. Calculate K_c for this equilibrium at 25°C ?
- $$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$$
- $3 \times 10^{24} \text{ mol/L}$
 - $5 \times 10^{21} \text{ mol/L}$
 - $2 \times 10^{20} \text{ mol/L}$
 - $5 \times 10^{22} \text{ mol/L}$
 - $7 \times 10^{25} \text{ mol/L}$
10. According to the VSEPR theory, the geometry of the SO_3 molecule is:
- pyramidal
 - tetrahedral
 - trigonal planar
 - distorted tetrahedron
 - square planar
11. What is the hybridization of the central atom in ClO_3^- ?
- sp
 - sp^2
 - sp^3
 - sp^3d
 - sp^3d^2
12. What is the formal charge on the sulfur atom in the resonance structure of SO_2 which has one single bond and one double bond?
- 0
 - +1
 - 1
 - +2
 - 2
13. Which type of organic compound does not contain a carbonyl group?
- ethers
 - carboxylic acids
 - ketones
 - aldehydes
 - esters

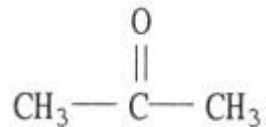
14. Combustion of a 0.9835-g sample of a compound containing only carbon, hydrogen, and oxygen produced 1.900 g of CO_2 and 1.070 g of H_2O . What is the empirical formula of the compound?
- (A) $\text{C}_2\text{H}_5\text{O}$
(B) $\text{C}_4\text{H}_{10}\text{O}_2$
(C) $\text{C}_4\text{H}_{11}\text{O}_2$
(D) $\text{C}_4\text{H}_{10}\text{O}$
(E) $\text{C}_2\text{H}_5\text{O}_2$
15. The molecular weight of the acetic acid ($\text{CH}_3\text{CO}_2\text{H}$), rounded to the nearest integer, is _____ amu.
- (A) 60
(B) 48
(C) 44
(D) 32
16. Calculate the percentage by mass of nitrogen in $\text{PtCl}_2(\text{NH}_3)_2$. (Pt=195.08, Cl=35.45, N=14.01, H=1.01)
- (A) 4.67
(B) 9.34
(C) 9.90
(D) 4.95
(E) 12.67
17. How many grams of NaOH (MW = 40.0) are there in 500.0 mL of a 0.175 M NaOH solution?
- (A) 2.19×10^{-3}
(B) 114
(C) 14.0
(D) 3.50
(E) 3.50×10^3
18. Of the elements below, _____ has the largest first ionization energy.
- (A) Li
(B) K
(C) Na
(D) H
(E) Rb
19. Which one of the following species has the electron configuration $[\text{Ar}]\text{3d}^4$?
- (A) Mn^{2+}
(B) Cr^{2+}
(C) V^{3+}
(D) Fe^{3+}
(E) K^+

20. A nonpolar bond will form between two _____ atoms of _____ electronegativity.

- (A) different, opposite
- (B) identical, different
- (C) different, different
- (D) similar, different
- (E) identical, equal

21. Which one of the following substances will not have hydrogen bonding as one of its intermolecular forces?

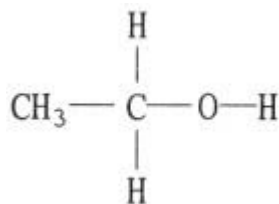
(A)



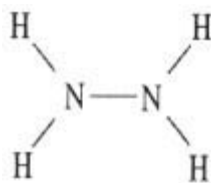
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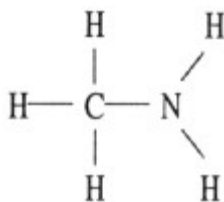
(C)



(D)



(E)



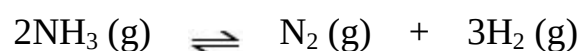
22. A solution is prepared by dissolving 23.7 g of CaCl_2 in 375 g of water. The density of the resulting solution is 1.05 g/mL. The concentration of Cl^- in this solution is _____ M. (Ca=40.08, Cl=35.45)

- (A) 0.214
- (B) 0.562
- (C) 1.12
- (D) 1.20
- (E) 6.64×10^{-2}

23. Which of the following aqueous solutions will have the highest boiling point?

- (A) 0.10 m Na_2SO_4
- (B) 0.20 m glucose
- (C) 0.25 m sucrose
- (D) 0.10 m NaCl
- (E) 0.10 m SrSO_4

24. Consider the following reaction at equilibrium:



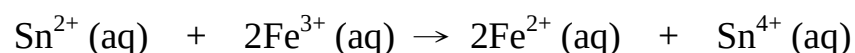
Le Châtelier's principle predicts that the moles of H_2 in the reaction container will increase with _____.

- (A) some removal of NH_3 from the reaction vessel (V and T constant)
- (B) a decrease in the total pressure (T constant)
- (C) addition of some N_2 to the reaction vessel (V and T constant)
- (D) a decrease in the total volume of the reaction vessel (T constant)
- (E) an increase in total pressure by the addition of helium gas (V and T constant)

25. Table below

Half-reaction	E° (V)
$\text{Cr}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Cr}(\text{s})$	-0.74
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$	-0.440
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{s})$	+0.771
$\text{Sn}^{4+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Sn}^{2+}(\text{aq})$	+0.154

The standard cell potential (E°_{cell}) for the voltaic cell based on the reaction below is _____ V.



- (A) +0.46
- (B) +0.617
- (C) +1.39
- (D) -0.46
- (E) +1.21

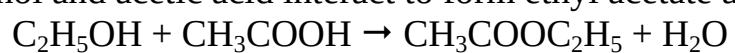
26. A disproportionation reaction is one in which

- (A) a single element is both oxidized and reduced.
- (B) a compound is separated into its constituent elements.
- (C) the ratio of combination of two elements in a compound changes.
- (D) aqueous ions combine to form an insoluble salt.
- (E) an insoluble salt separates into ions.

二、簡答題（共 22 分）

- Complete the following reaction : $\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O}$ (5分)
- Calculate the bond energy of C-F given that the heat of atomization of CHFClBr is 1502 kJ/mol, and that the bond energies of C-H, C-Br, and C-Cl are 413, 276, and 328 kJ/mol, respectively. (6分)
- Write net ionic equations to show the reactions that occur in a $\text{CO}_3^{2-}/\text{HCO}_3^-$ buffer solution when: (7分)
 - (a) a strong acid is added
 - (b) a strong base is added

4. Ethanol and acetic acid interact to form ethyl acetate and water, according to the equation:



When two moles each of ethanol and acetic acid are allowed to react at 100°C in a sealed tube, equilibrium is established when two thirds of a mole of each of the reactants remains.

Calculate the equilibrium constant.(4分)