

科目：普通化學

適用：應化系二

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。

本試題

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第 1 頁

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## 一、單選題 (68%，每題 4 分)

1. Consider the following balanced equation:  $5A(g) + B(g) \rightarrow 3C + 4D$  When equal masses of A and B are reacted, which is limiting?  
 [A] If the molar mass of A is less than the molar mass of B, then B must be limiting.  
 [B] If the molar mass of A is greater than the molar mass of B, then B must be limiting.  
 [C] If the molar mass of A is less than the molar mass of B, then A must be limiting.  
 [D] If the molar mass of A is greater than the molar mass of B, then A must be limiting.  
 [E] More information is needed.
2. Which of the following statements is(are) true? Oxidation and reduction  
 [A] accompany all chemical changes. [B] cannot occur independently of each other.  
 [C] result in a change in the oxidation states of the species involved.  
 [D] describe the loss and gain of electron(s), respectively. [E] B, C and D are correct.
3. Identify the reaction  $NaOH + HCl \rightarrow NaCl + H_2O$  using the following choices:  
 [A] Acid-base reaction [B] Combustion reaction [C] Precipitation reaction  
 [D] Oxidation-reduction reaction [E] More than one of answers A-D apply.
4. Which of the following relationships is(are) true?  
 [A]  $nT = \text{constant}$  when pressure and volume are held constant.  
 [B]  $P/n = \text{constant}$  when volume and temperature are held constant.  
 [C]  $PV = \text{constant}$  when temperature and moles of gas are held constant.  
 [D]  $V/T = \text{constant}$  when pressure and moles of gas are held constant. [E] All of these are true.
5. Consider the following reaction:  $2HF(g) \rightleftharpoons H_2(g) + F_2(g)$  ( $K = 1.00 \times 10^{-2}$ ) Given 1.00 mol of  $HF(g)$ , 1.00 mol of  $H_2(g)$ , and 1.00 mol of  $F_2(g)$  are mixed in a 10.0-L flask, determine the reaction quotient,  $Q$ , and the net direction to achieve equilibrium.  
 [A]  $Q = 0.100$ ; the equilibrium shifts to the right. [B]  $Q = 0.100$ ; the equilibrium shifts to the left.  
 [C]  $Q = 1.00$ ; the equilibrium shifts to the left. [D]  $Q = 1.00$ ; the equilibrium shifts to the right.  
 [E]  $Q = 1.00$ ; the system is at equilibrium.
6. The hydrogen sulfate or 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?  
 [A]  $HSO_4^- + H_2O \rightarrow H_2SO_4 + OH^-$  [B]  $HSO_4^- + H_2O \rightarrow SO_4^{2-} + H_3O^+$

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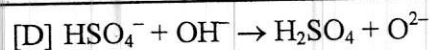
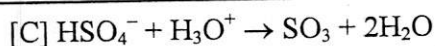
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[E] none of these

7. A solution containing 10. mmol of  $\text{CO}_3^{2-}$  and 5.0 mmol of  $\text{HCO}_3^-$  is titrated with 1.0 M HCl. What volume of HCl must be added to reach the first equivalence point?

[A] 5.0 mL      [B] 10. mL      [C] 15 mL      [D] 20. mL      [E] 25 mL

8. Calculate  $\Delta E$  for a system that releases 23 J of heat while 65 J of work is done on it.

[A] -88 J      [B] -42 J      [C] 23 J      [D] 42 J      [E] 88 J

9. For the reaction  $\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow \text{CH}_4(\text{g}) + 2\text{O}_2(\text{g})$ ,  $\Delta H^\circ = 803 \text{ kJ}$  which of the following will increase  $K$ ?

[A] increasing the temperature of system      [B] increasing the volume of system  
[C] decreasing the number of moles of methane      [D] all of these.      [E] none of these.

10. For which of the following elements does the electron configuration for the lowest energy state show a partially filled d orbital?

[A] Rb      [B] S      [C] Ti      [D] Ca      [E] Kr

11. For which compound is resonance required to describe the structure adequately?

[A]  $\text{CO}_3^{2-}$       [B] HCN      [C]  $\text{NH}_4^+$       [D]  $\text{PCl}_3$       [E] none of these

12. Select the correct molecular structure for  $\text{XeCl}_4$ .

[A] octahedral      [B] pyramidal      [C] square planar      [D] tetrahedral      [E] none of these

13. The fact that  $\text{O}_2$  is paramagnetic can be explained by

[A] the Lewis structure of  $\text{O}_2$ .      [B] the molecular-orbital diagram for  $\text{O}_2$ .  
[C] resonance.      [D] hybridization of atomic orbitals in  $\text{O}_2$ .      [E] a violation of the octet rule.

14. The major attractive force in HF is

[A] ionic bonding      [B] London dispersion forces      [C] dipole-dipole interactions  
[D] hydrogen bonding      [E] none of these

15. Brass is an example of

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[A] a superconductor.

[B] an interstitial alloy.

[C] a network solid.

[D] a substitutional alloy.

[E] none of these

16. Which of the following complexes shows geometric isomerism?

[A]  $\text{Na}_3[\text{CoCl}_6]$ [B]  $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2$ [C]  $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]\text{SO}_4$ [D]  $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$ [E]  $\text{K}[\text{Co}(\text{H}_2\text{O})_2\text{Cl}_4]$ 

17. Which of the following is not a charged species?

[A]  $\alpha$  particle[B]  $\beta$  particle[C]  $\gamma$  particle

[D] all of these

[E] none of these

## 二、簡答題 (32%)

1. Write the formula for:

(A) (3%) potassium dichromate

(B) (3%) hypochlorous acid

2. For the molecule

$$\begin{array}{c} \text{CH}_3 \quad \text{O} \\ | \quad | \\ \text{CH}_3 - \text{CH} - \text{C} - \text{C} - \text{N} \end{array}$$

(A) (4%) Complete the Lewis structure

(B) (4%) How many  $\sigma$  bonds and  $\pi$  bonds does this molecule has?

(C) (3%) What is the hybridization of the nitrogen atom?

(D) (3%) What is the bond angle of the C-C-O bonds?

3. The following data were collected in two studies of the reaction  $\text{A} + 2\text{B} \rightarrow \text{C} + \text{D}$ 

	$[\text{B}]_0 = 2.5 \text{ M}$	$[\text{B}]_0 = 5.0 \text{ M}$
	Experiment 1	Experiment 2
Time (s)	$[\text{A}] (\text{M}) \times 10^{-2}$	$[\text{A}] (\text{M}) \times 10^{-2}$
0	10.0	10.0
20	6.67	5.00
40	5.00	3.33
60	4.00	2.50
80	3.33	2.00
100	2.86	1.67
120	2.50	1.43

(A) (8%) Specify the orders of the this reaction with respect to [A] and [B]. Explain your answers.

(B) (4%) Calculate the value of the rate constant.