

科目：普通化學

適用：應化系

編號：376

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
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本 試 題

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第 1 頁

一、單選題：(75% total, 3% each)

1. Which is the correct name for $\text{HClO}(aq)$?
 A) hydrochloric acid B) hyperchloric acid C) hyperchlorous acid
 D) hypochlorous acid E) hypochloric acid
2. The empirical formula of compound S is CH ; its molar mass is 104.1. What is the molecular formula of styrene?
 A) C_2H_4 . B) C_6H_6 . C) C_8H_8 . D) $\text{C}_{10}\text{H}_{12}$. E) none of these.
3. An aqueous solution of silver nitrate is added to an aqueous solution of potassium chromate, and this reaction produces a solid. What is the formula for the solid?
 A) AgCrO_4 B) Ag_2CrO_4 C) AgK . D) KNO_3 . E) K_2NO_3 .
4. What is the oxidation state of chromium in $\text{K}_2\text{Cr}_2\text{O}_7$?
 A) +6. B) +4. C) +2. D) -3. E) -5
5. Four identical 1.0-L flasks contain the gases Ne, N_2 , CH_4 , and NH_3 , each at 25°C and 1 atm pressure. Which gas sample has the greatest number of molecules?
 A) CH_4 . B) N_2 . C) Ne. D) NH_3 .
 E) All the gases have the same number of molecules.
6. Consider two samples of helium in separate containers of the same volume. Sample 1 has an absolute temperature three times that of Sample 2. Both samples are at the same pressure. Calculate the ratio n_1/n_2 .
 A) 9:1. B) 3:1. C) 1:1. D) 1:3. E) 1:9.
7. Consider the following equilibrium: $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g)$ with $K = 2.3 \times 10^{-6}$. 2.00 mol each of all reactants and products is placed in a 1.00-L container. Calculate the equilibrium concentration of N_2 .
 A) 1.0 M B) 1.5 M C) 2.0 M D) 2.5 M E) 3.0 M
8. The equilibration process for the reaction $4\text{HCl}(g) + \text{O}_2(g) \rightleftharpoons 2\text{Cl}_2(g) + 2\text{H}_2\text{O}(g)$ is studied by initially charging a closed reaction vessel at 750 K with 2.00 atm of HCl , 1.00 atm of O_2 , 2.00 atm of Cl_2 , and 1.00 atm of H_2O . At this temperature $K = 1.00$. To achieve equilibrium, the original reaction mixture will
 A) produce more water and oxygen only B) shift toward products
 C) experience no change in component pressures D) shift toward reactants
 E) always move in a direction to lower the total pressure

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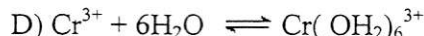
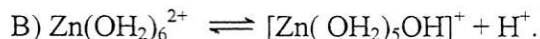
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9. Which of the following reactions is associated with the definition of K_b ?

E) none of these

10. Calculate the pH of the $1.0 \times 10^{-10} M$ HCl aqueous solutions. Choose your answer from the given pH ranges.

A) pH 0.00–2.99

B) pH 3.00–5.99

C) pH 6.00–8.99

D) pH 9.00–10.99

E) pH 11.00–14.00

11. A student titrates an unknown weak acid, HA, to a pale pink phenolphthalein endpoint with 25.0 mL of 0.100 M NaOH. The student then adds 12.5 mL of 0.100 M HCl. The pH of the resulting solution is 4.7. Which of the following statements is true?

A) At pH 4.7, half of the conjugate base, A^- , has been converted to HA.B) The pK_a of the acid is less than 4.7.C) The pK_a of the acid is greater than 4.7.D) The pK_a of the acid is 4.7.

E) More than one of the above statements are correct.

12. How many moles of $Fe(OH)_2$ [$K_{sp} = 1.8 \times 10^{-15}$] will dissolve in 1 L of water buffered at pH = 11.00?A) 5.0×10^{-12} mol.B) 1.8×10^{-11} mol.C) 1.8×10^{-9} mol.D) 4.0×10^{-8} mol.E) 8.0×10^{-6} mol.

13. Which of the following statements is(are) true?

A) A chemist takes the point of view of the surroundings when determining the sign for work or heat.

B) In exothermic reactions, the reactants are lower in potential energy than the products.

C) The heat of reaction and change in enthalpy can always be used interchangeably.

D) Enthalpy is a state function.

E) At least two of these statements are true.

14. The process $H_2O(g) \rightarrow H_2O(l)$ takes place at 1 atm and 95°C. What is ΔS ?

A) More information is needed.

B) less than zero.

C) equal to zero.

D) greater than zero.

15. The standard potential for the reaction $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$ is 1.56 V. Given that the standard reduction potential for $Ag^+ + e^- \rightarrow Ag$ is 0.80 V, determine the standard reduction potential for $Zn^{2+} + 2e^- \rightarrow Zn$.

A) 0.76 V.

B) 0.04 V.

C) -0.38 V.

D) -0.76 V.

E) none of these.

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16. Consider the freezing of liquid water at -10°C . For this process what are the signs for ΔH and ΔG , respectively?

- A) - - B) + - C) - + D) + +

17. What is the total number of electrons that can be accommodated in the level corresponding to $n = 5$?

- A) 2. B) 8. C) 18. D) 32. E) 50.

18. What is the electron configuration for Cr^{2+} ?

- A) $[\text{Ar}] 4s^1 3d^5$. B) $[\text{Ar}] 4s^2 3d^4$. C) $[\text{Ar}] 3d^4$. D) $[\text{Ar}] 4s^2 3d^2$. E) $[\text{Ar}] 4s^1 3d^3$.

19. Which of the following species is paramagnetic?

- A) H_2 . B) B_2 . C) C_2 . D) N_2 . E) none of these.

20. Which of the compounds below is an example of a network solid?

- A) $\text{SiO}_2(s)$. B) $\text{S}_8(s)$. C) $\text{NaCl}(s)$. D) $\text{MgO}(s)$. E) $\text{C}_{25}\text{H}_{52}(s)$.

21. Doping Se with As would produce a(n) _____ semiconductor with _____ conductivity compared to pure Se.

- A) n -type, increased. B) p -type, increased. C) n -type, decreased.
D) intrinsic, identical. E) p -type, decreased.

22. Predict the deviation from Raoult's law when two liquids are mixed and the heat of the solution is large and the reaction exothermic.

- A) negative deviation. B) positive deviation.
C) relatively ideal (small or zero deviation)

23. Which group contains two elements that exhibit +2 and +4 oxidation states?

- A) Group 1A. B) Group 3A. C) Group 5A. D) Group 7A. E) Group 4A.

24. Identify the missing particle in the following equation: ${}^{238}_{92}\text{U} \rightarrow {}^4_2\text{He} + ?$

- A) ${}^{242}_{90}\text{Th}$. B) ${}^{242}_{94}\text{Pu}$. C) ${}^{234}_{92}\text{U}$. D) ${}^{234}_{90}\text{Th}$. E) none of these.

25. Which of the following has the lowest boiling point?

- A) butane. B) ethane. C) methane. D) propane.
E) All of these have the same boiling point.

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二、簡答與計算題 (25%)，請列出關鍵公式與計算過程。

1. Refer to the SeF_4 molecule. (14% total, 2% each)
 - (a) Is the molecule an ionic compound?
 - (b) Write the Lewis structure for the molecule.
 - (c) Determine the formal charge of Se atom.
 - (d) Describe the molecular structure of the molecule.
 - (e) Label the F-Se-F bond angle in the molecule.
 - (f) Is the molecule polar or nonpolar?
 - (g) Determine the hybrid atomic orbitals used for bonding in the molecule.
2. At 760 K, acetaldehyde decomposes to carbon monoxide and methane: $\text{CH}_3\text{CHO} \longrightarrow \text{CH}_4 + \text{CO}$. A plot of $\ln [\text{CH}_3\text{CHO}]$ versus time is linear. After 500. s, $[\text{CH}_3\text{CHO}]$ decreases to one half of its initial value of 0.10 M.
 - (a) Determine the reaction order for acetaldehyde. (3%)
 - (b) Determine the value of the rate constant. (2%)
3. Write a balanced equation for the following reactions. (6% total, 3% each)
 - (a) Sodium peroxide with $\text{H}_2\text{O}(l)$.
 - (b) Formation of *n*-propyl propanoate.

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