

科目：普通化學

適用：應化系

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：(45% total, 3% each)

1. Which of the following compounds has the same percent composition by mass as benzene?
A) acetylene B) cyclobutadiene C) styrene D) two of these E) all of these
2. 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 greater than the molar mass of B, then A 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 less than the molar mass of B, then B must be limiting.
E) More information is needed.
3. You have separate aqueous solutions of HCl and H_2SO_4 with the same concentrations. You wish to neutralize an aqueous solution of NaOH. Which acidic solution would require more volume to neutralize the base?
A) the H_2SO_4 solution B) the HCl solution
C) You need to know the concentrations of the acidic solutions to answer this question.
D) You need to know the volume and concentration of the NaOH solution to answer this question.
E) You need to know the concentrations of the acid and bases and the volume of the base to answer this question.
4. How is the observed pressure of a gas related to the ideal pressure?
A) They are equal. B) The relationship depends on the gas.
C) The observed pressure is less than the ideal pressure.
D) The observed pressure is greater than the ideal pressure. E) none of these
5. Which of the following statements concerning equilibrium is *not* true?
A) A system that is disturbed from an equilibrium condition responds in such a way as to restore equilibrium.
B) A system moves spontaneously toward a state of equilibrium.
C) Equilibrium in molecular systems is dynamic, with two opposing processes balancing one another.
D) The value of the equilibrium constant for a given reaction mixture depends on the direction from which equilibrium is attained.
E) The equilibrium constant is dependent of temperature.
6. The conjugate base of a weak acid is

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13. Which of the following coordination compounds will form a precipitate when treated with an aqueous solution of AgNO_3 ?
- A) $\text{Na}_3[\text{CrCl}_6]$ B) $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$ C) $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$
 D) $\text{Na}_3[\text{Cr}(\text{CN})_6]$ E) all of these
14. The molar mass of a solid as determined by freezing-point depression is 10% higher than the true molar mass. Which of the following experimental errors could account for this discrepancy?
- A) Before the solution was prepared, the container was rinsed with solvent and not dried.
 B) The solid dissociated slightly into two particles when it dissolved.
 C) More than the recorded amount of solvent was pipetted into the solution.
 D) A and C E) all of these
15. Which of the following complexes would be diamagnetic (all electrons paired)?
- A) $[\text{Co}(\text{CN})_6]^{3-}$ B) $[\text{Mn}(\text{CN})_6]^{4-}$ C) $[\text{Cr}(\text{CN})_6]^{3-}$ D) $[\text{V}(\text{CN})_6]^{3-}$

二、簡答與計算題 (55%)，請列出關鍵公式與計算過程。

1. Write the formula for each compound: (a) Gallium oxide, (b) Nickel(II) carbonate, and (c) Hydrobromic acid. (9% total, 3% each)
2. Iodate can react with iodide to form iodine in acidic solution. (8% total, 4% each)
 - (a) Balance the reaction.
 - (b) What volume of 0.200 M HCl is needed to produce 2.00×10^{-3} mol of iodine with an excess of potassium iodate and potassium iodide?
3. The valve between a 3.00-L tank containing $\text{O}_2(\text{g})$ at 7.00 atm and a 3.00-L tank containing $\text{Ne}(\text{g})$ at 5.00 atm is opened. (8% total, 4% each)
 - (a) Calculate the ratio of partial pressures (O_2/Ne) in the container.
 - (b) Calculate the ratio of diffusion rate (O_2/Ne) in the container.
4. The standard enthalpy of combustion of ethene gas is -1411.1 kJ/mol at 298 K. Given the following enthalpies of formation: $\text{CO}_2(\text{g})$, -393.5 kJ/mol; $\text{H}_2\text{O}(\text{l})$, -285.8 kJ/mol. (8% total, 4% each)
 - (a) Write the balanced equation for combustion of ethene.
 - (b) Calculate ΔH_f° for ethene.
5. Do all reactions have a specific temperature where $K = 1.00$? (2%) Why? (4%)

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6. The osmotic pressure of a solution saturated with a salt M_2X_3 is 1.96×10^{-2} atm at 25°C . (8% total)
- (a) What is the expected i ? (2%)
- (b) Calculate the solubility of M_2X_3 in the unit of molarity. (3%)
- (c) Calculate K_{sp} for M_2X_3 . (3%)
7. An electron is promoted from the π to the π^* molecular orbital in an N_2 molecule following the absorption of a photon. (8% total)
- (a) Which region of the electromagnetic spectrum is absorbed? (2%)
- (b) Use the MO model to give the electron configuration for the excited N_2 . (3%)
- (c) Compare the bond length in the non-excited molecule with that in the excited molecule. (3%)

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