

科目：普通化學 適用：應光系

編號：425

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

一、單選題：60%，每小題 5%，答錯不倒扣分數

1. You are given a solution of the weak base Novocain, Nvc. Its pH is 11.00. You add to the solution a small amount of a salt containing the conjugate acid of Novocain, NvcH⁺.

Which statement is true?

- (A) The pH decreases and the pOH increases.
 (B) The pH and the pOH both increase.
 (C) The pH and the pOH both decrease.
 (D) The pH and the pOH remain unchanged.
 (E) The pH increases and pOH decreases.

2. Which of the following does **not** represent a conjugate acid-base pair?

- (A) HCN and NH₃
 (B) HF and F⁻
 (C) H₃O⁺ and H₂O
 (D) C₅H₅NH⁺ and C₅H₅N
 (E) none of these

3. How many moles of sodium phosphate are required to react completely with 5.4 mol of calcium nitrate to form sodium nitrate and calcium phosphate?

- (A) 7.2 mol
 (B) 3.6 mol
 (C) 5.4 mol
 (D) 1.8 mol
 (E) 2.7 mol

4. At room temperature cyclohexane exists almost exclusively in the chair conformation (99.99%). But at 800 °C, 30% of the cyclohexane molecules exist in the twist-boat conformation.

What is the value of the equilibrium constant for the following reaction at 800 °C?



- (A) 0.43
 (B) 0.30
 (C) 0.23
 (D) 0.70
 (E) 2.33

5. Which of the following statements is true concerning ideal gases?

- (A) A gas exerts pressure as a result of the collisions of the gas molecules with the walls of the container.
 (B) The temperature of the gas sample is directly related to the average velocity of the gas particles.
 (C) At STP, 1.0 L of Ar(g) contains about twice the number of atoms as 1.0 L of Ne(g) because the molar mass of Ar is about twice that of Ne.
 (D) The gas particles in a sample exert attraction on one another.
 (E) All of these statements are false.

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第 2 頁

6. Which of the following would be a good sacrificial electrode to protect an iron boat from corrosion?

Half Reaction	$E^\circ(\text{V})$
$\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$	-0.23
$\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}$	-0.44
$\text{Cr}^{3+} + 3\text{e}^- \rightarrow \text{Cr}$	-0.50
$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$	-1.66

- (A) Aluminum
(B) Nickel
(C) Chromium
(D) B and C
(E) More information needed to answer the question

7. Which of the following statements is true of second ionization energies?

- (A) That of Al is higher than that of Mg because Mg wants to lose the second electron, so it is easier to take the second electron away.
(B) That of Al is lower than that of Mg because Mg wants to lose the second electron, so the energy change is greater.
(C) That of Al is higher than that of Mg because the electrons are taken from the same energy level, but the Al atom has one more proton.
(D) That of Al is lower than that of Mg because the second electron taken from Al is in a p orbital, so it is easier to take away.
(E) The second ionization energies are equal for Al and Mg.

8. Consider the following numbered processes:

- 1) $\text{A} \rightarrow 2\text{B}$
- 2) $\text{B} \rightarrow \text{C} + \text{D}$
- 3) $\text{E} \rightarrow 2\text{D}$

ΔH for the process $\text{A} \rightarrow 2\text{C} + \text{E}$ is

- (A) $\Delta H_1 + \Delta H_2 + \Delta H_3$
(B) $\Delta H_1 + \Delta H_2$
(C) $\Delta H_1 + 2\Delta H_2 - \Delta H_3$
(D) $\Delta H_1 + \Delta H_2 - \Delta H_3$
(E) $\Delta H_1 - 2\Delta H_2 + \Delta H_3$

9. Which ion is planar?

- (A) SCl_5^-
(B) CO_3^{2-}
(C) ClO_3^-
(D) SO_4^{2-}
(E) PCl_4^+

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10. Use the following initial rate data for the reaction in aqueous solution to determine the rate law.

$[\text{CH}_3\text{COCH}_3]_0 (M)$	$[\text{Br}_2]_0 (M)$	$[\text{H}^+]_0 (M)$	$\frac{\Delta[\text{Br}_2]}{\Delta t} (M/s)$
1.00	1.00	1.00	4.0×10^{-3}
2.00	1.00	1.00	8.0×10^{-3}
2.00	2.00	1.00	8.0×10^{-3}
1.00	2.00	2.00	8.0×10^{-3}

- (A) $\text{Rate} = k[\text{Br}_2][\text{H}^+]$
 (B) $\text{Rate} = k[\text{CH}_3\text{COCH}_3][\text{H}^+]$
 (C) $\text{Rate} = k[\text{CH}_3\text{COCH}_3][\text{Br}_2][\text{H}^+]$
 (D) $\text{Rate} = k[\text{CH}_3\text{COCH}_3][\text{Br}_2]$
 (E) $\text{Rate} = k[\text{CH}_3\text{COCH}_3][\text{Br}_2][\text{H}^+]^2$

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

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

12. When a nonvolatile solute is added to a volatile solvent, the solution vapor pressure _____, the boiling point _____, the freezing point _____, and the osmotic pressure across a semipermeable membrane _____.

- (A) decreases, increases, decreases, increases
 (B) decreases, increases, decreases, decreases
 (C) increases, increases, decreases, increases
 (D) increases, decreases, increases, decreases
 (E) decreases, decreases, increases, decreases

二、問答題：40%

1. 請寫出理想氣體狀態方程式(Ideal gas equation or ideal gas law)，說明方程式中使用之各種符號所代表意義，並敘述何謂理想氣體？(20%)
2. 請敘述何謂高分子(Polymer)，並舉出兩種你所知道的高分子材料，另請你舉出高分子材料於光電領域之應用包含哪些？發揮你的想像力，盡可能地寫出你的答案。(20%)