

科目：普通化學 適用：應光系

編號：505

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. Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?

- (A)  $\text{NH}_3$  and  $\text{NCl}_3$   
 (B)  $\text{ZnO}$  and  $\text{ZnCl}_2$   
 (C)  $\text{H}_2\text{O}$  and  $\text{HI}$   
 (D)  $\text{NO}$  and  $\text{NO}_2$   
 (E)  $\text{CH}_4$  and  $\text{CO}_2$

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2. When the equation  $\text{NH}_3 + \text{O}_2 \rightarrow \text{NO} + \text{H}_2\text{O}$  is balanced with the smallest set of integers, the sum of the coefficients is

- (A) 4  
 (B) 12  
 (C) 14  
 (D) 19  
 (E) 24

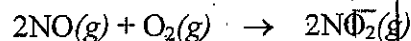
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3. To calculate the concentration in molarity of a salt solution, you need to know

- (A) the mass of the salt added to the solution and the volume of water added to the solution.  
 (B) the mass of the salt added to the solution and the total volume of the solution.  
 (C) the mass of the salt added, the molar mass of the salt, and the total volume of the solution.  
 (D) the molar mass of the salt and the total volume of the solution.  
 (E) the mass of the salt added, the molar mass of the salt, the volume of water added, and the total volume of the solution.

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4. The oxidation of nitric oxide to nitrogen dioxide is



If 100.0 mL of  $\text{NO}$  (at STP) reacts with 400.0 mL of  $\text{O}_2$  at STP, calculate the partial pressure of  $\text{NO}_2$  in the final reaction mixture.

- (A) 0.222 atm  
 (B) 0.333 atm  
 (C) 0.286 atm  
 (D) 0.250 atm  
 (E) 1.00 atm

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5. If a solution exhibits a negative deviation from Raoult's law, the vapor pressure of the solution is \_\_\_\_\_ what would be expected ideally.

- (A) greater than  
 (B) less than  
 (C) equal to

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6. The conjugate acid and conjugate base of bicarbonate ion,  $\text{HCO}_3^-$ , are, respectively,

- (A)  $\text{H}_3\text{O}^+$  and  $\text{OH}^-$
- (B)  $\text{H}_3\text{O}^+$  and  $\text{CO}_3^{2-}$
- (C)  $\text{H}_2\text{CO}_3$  and  $\text{OH}^-$
- (D)  $\text{H}_2\text{CO}_3$  and  $\text{CO}_3^{2-}$
- (E)  $\text{CO}_3^{2-}$  and  $\text{OH}^-$

7. What is the molarity of a sodium hydroxide solution if 25.0 mL of this solution reacts exactly with 22.30 mL of 0.253 M sulfuric acid?

- (A) 0.113 M
- (B) 0.226 M
- (C) 0.284 M
- (D) 0.451 M
- (E) 0.567 M

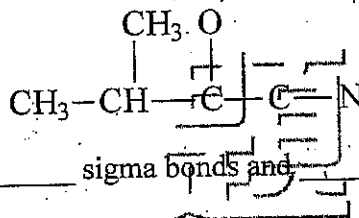
8. Which of the following statements about quantum theory is *incorrect*?

- (A) The energy and position of an electron cannot be determined simultaneously.
- (B) Lower energy orbitals are filled with electrons before higher energy orbitals.
- (C) When filling orbitals of equal energy, two electrons will occupy the same orbital before filling a new orbital.
- (D) No two electrons can have the same four quantum numbers.
- (E) All of these are correct.

9. Which of the following molecules has a zero dipole moment?

- (A)  $\text{XeF}_2$
- (B)  $\text{NCl}_3$
- (C)  $\text{H}_2\text{O}$
- (D)  $\text{SCl}_4$
- (E)  $\text{ICl}_3$

10. Complete the Lewis structure for the following molecule.



This molecule has \_\_\_\_\_ sigma bonds and \_\_\_\_\_ pi bonds.

- (A) 4, 5
- (B) 13, 3
- (C) 11, 5
- (D) 13, 2
- (E) 6, 3

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11. When the substances in the equation below are at equilibrium at pressure  $P$  and temperature  $T$ , how can the equilibrium be shifted to favor the products?



Change in enthalpy = -2.0 kJ.

- (A) Decrease the temperature.  
 (B) Add a catalyst.  
 (C) Increase the pressure by adding an inert gas such as nitrogen.  
 (D) Increase the pressure by means of a moving piston at constant temperature.  
 (E) Allow some gas to escape at constant pressure and temperature.

12. A  $p$ -type semiconductor

- (A) is made by doping host atoms with atoms having more valence electrons than the host.  
 (B) is made by doping host atoms with atoms having fewer valence electrons than the host.  
 (C) has electrons that lie close in energy to the conduction bands.  
 (D) two of these.  
 (E) none of these.

二、問答題：40%

1. 請以圖示法表示出一個完整的濃差電池 (Concentration Cell)，並以箭頭註明其電子流動之方向？(20%)

2. 請敘述普通化學科目內容中，應用於材料以及光電領域之知識與觀念包含哪些？發揮你的想像力，盡可能地寫出你的答案。(20%)