

## 科目：普通化學

適用：應光系

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。

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## 一、單選題：60%，每小題 5%，答錯不倒扣分數

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

- I. O and F have the same number of neutrons.
- II.  $O^{2-}$  has the same number of electrons as Ne.
- III. C and N are isotopes of each other because their mass numbers are the same.

- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) II and III only

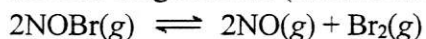
2. Which of the following solutions contains the greatest total ion concentration?

- (A) One mole of potassium hydroxide dissolved in 1.0 L of solution.
- (B) One mole of sodium phosphate dissolved in 1.0 L of solution.
- (C) One mole of potassium chloride dissolved in 1.0 L of solution.
- (D) One mole of iron(II) nitrate dissolved in 1.0 L of solution.
- (E) At least two of these solutions have an equal number of ions, and these contain the greatest total ion concentration.

3. A balloon contains 10.0 g of neon gas. With the temperature kept constant, 10.0 g of argon gas is added. What happens?

- (A) The volume of the balloon expands by less than 2 times.
- (B) The volume of the balloon expands by more than 2 times.
- (C) The balloon doubles in volume.
- (D) The balloon stays the same size, but the pressure increases.
- (E) not enough information.

4. Consider the following reaction (assume an ideal gas mixture).



A 2.0-L vessel was initially filled with pure NOBr, at a pressure of 3.9 atm, at 310 K.

After equilibrium was reached, the volume was increased to 2.0 L, while the temperature was kept at 300 K. This will result in

- (A) a shift in the equilibrium position to the right.
- (B) an increase in  $K_p$ .
- (C) a shift in the equilibrium position to the left.
- (D) a decrease in  $K_p$ .
- (E) not enough information.

5. What concentration of HF ( $K_a = 7.2 \times 10^{-4}$ ) has the same pH as that of 0.070 M HCl?

- (A) 6.8 M
- (B) 0.15 M
- (C)  $4.0 \times 10^{-6}$  M
- (D) 0.070 M
- (E) none of these.

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6. Consider a solution of 2.0 M HCN and 1.0 M NaCN ( $K_a$  for HCN =  $6.2 \times 10^{-10}$ ). Which of the following statements is true?
- (A) The pH will be below 7.00 because the concentration of the acid is greater than that of the base.
- (B) The buffer will be more resistant to pH changes from addition of strong acid than to pH changes from addition of strong base.
- (C)  $[\text{OH}^-] > [\text{H}^+]$
- (D) The solution is not a buffer because  $[\text{HCN}]$  is not equal to  $[\text{CN}^-]$ .
- (E) All of these statements are true.
7. Two metals of equal mass with different heat capacities are subjected to the same amount of heat. Which undergoes the smaller change in temperature?
- (A) The metal with the lower heat capacity.
- (B) Both undergo the same change in temperature.
- (C) The metal with the higher heat capacity.
- (D) To determine this, you need to know which metals you are talking about.
- (E) To determine this, you need to know the initial temperatures of the metals.
8. The following two half-reactions take place in a galvanic cell. At standard conditions, what species are produced at each electrode?
- $$\text{Sn}^{2+} + 2\text{e}^- \rightarrow \text{Sn} \quad E^\circ = -0.14 \text{ V}$$
- $$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu} \quad E^\circ = 0.34 \text{ V}$$
- (A) Sn is produced at the anode, and Cu is produced at the cathode.
- (B) Cu is produced at the anode, and  $\text{Sn}^{2+}$  is produced at the cathode.
- (C) Sn is produced at the cathode, and  $\text{Cu}^{2+}$  is produced at the anode.
- (D) Cu is produced at the cathode, and  $\text{Sn}^{2+}$  is produced at the anode.
- (E) Sn is produced at the anode, and  $\text{Cu}^{2+}$  is produced at the cathode.
9. As indicated by Lewis structures, which of the following would probably *not* exist as a stable molecule?
- (A)  $\text{C}_2\text{H}_2$
- (B)  $\text{CH}_3\text{O}$
- (C)  $\text{CH}_2\text{O}$
- (D)  $\text{CH}_3\text{OH}$
- (E)  $\text{C}_3\text{H}_4$
10. The reaction  $\text{A} \rightarrow \text{B} + \text{C}$  is known to be zero order in A with a rate constant of  $4.8 \times 10^{-2} \text{ mol/L} \cdot \text{s}$  at  $25^\circ \text{C}$ . An experiment was run at  $25^\circ \text{C}$  where  $[\text{A}]_0 = 2.0 \text{ M}$ . What is the concentration of B after 4.0s?
- (A) 2.0M
- (B)  $1.9 \times 10^{-1} \text{ M}$
- (C)  $1.1 \times 10^{-1} \text{ M}$
- (D)  $5.5 \times 10^{-1} \text{ M}$
- (E)  $1.2 \times 10^{-2} \text{ M}$

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11. Which of the following statements is true about the vapor pressures of methane ( $\text{CH}_4$ ) and ammonia ( $\text{NH}_3$ )?
- (A) The vapor pressure of ammonia is equal to the vapor pressure of methane.
- (B) The vapor pressure of methane is greater than the vapor pressure of methane because methane has more hydrogen bonding than ammonia.
- (C) The vapor pressure of ammonia is greater than the vapor pressure of methane because ammonia is polar and methane is nonpolar.
- (D) The vapor pressure of ammonia is less than the vapor pressure of methane because ammonia is nonpolar and methane is polar.
- (E) None of these statements is true.
12. At a given temperature, you have a mixture of benzene ( $P_{\text{vap}} = 745 \text{ torr}$ ) and toluene ( $P_{\text{vap}} = 290 \text{ torr}$ ). The mole fraction of benzene in the solution is 0.590. Assuming ideal behavior, calculate the mole fraction of toluene in the vapor above the solution.
- (A) 0.590
- (B) 0.778
- (C) 0.213
- (D) 0.355
- (E) 0.641

## 二、問答題：40%

1. 請解釋何謂電化學(electrochemistry)? 何謂氧化還原反應(redox reactions)? 並解釋賈法尼電池(galvanic cell)與電解池(electrolytic cell)之間的差異為何?(20%)
2. 請敘述光電科技領域所使用之材料與普通化學知識相關性為何? 發揮你的想像力，盡可能地寫出你的答案。(20%)