

科目：普通化學 適用：應化系二

編號：341

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  
共 5 頁  
第 1 頁

## 一、是非題 (12%，每題 2 分)

1. As predicted from the two Lewis structures for ozone ( $O_3$ ), one oxygen-oxygen bond is stronger than the other oxygen-oxygen bond.
2. The scattering of light by particles is called the Tyndall effect and is often used to distinguish between a suspension and a true solution.
3. The standard reducing potential for the half-reaction  $K^+ + e^- \rightarrow K$  ( $E^\circ = -2.92$  V) is more negative than the half-reaction  $Zn^{2+} + 2e^- \rightarrow Zn$  ( $E^\circ = -0.76$  V) means that the oxidation of Zn to  $Zn^{2+}$  is more easy than the oxidation of K to  $K^+$ .
4. The wavelength of light emitted if the electron drops from  $n = 3$  to  $n = 2$  is shorter than the wavelength of light emitted if the electron falls from  $n = 3$  to  $n = 1$ .
5. For solution of any weak acid HA,  $[H^+]$  decreases as  $[HA]_0$  decrease, but the percent dissolution increase as  $[HA]_0$  decreases.
6. The second law of thermodynamics states that the total entropy of the universe increases in any spontaneous process.

## 二、選擇題 (60%，每題 3 分)

1. How many significant figures are there in the following measurement: 0.0503 kg?  
[A] 5                      [B] 4                      [C] 3                      [D] 2                      [E] 1
2. Which of the following is false?  
[A]  $Na_2SO_4$ , disodium sulfate                      [B] CaS, calcium sulfide  
[C]  $CO_2$ , carbon dioxide                              [D]  $N_2O_5$ , dinitrogen pentoxide  
[E]  $FeCl_3$ , ferric chloride
3. Which of the ways of describing solution composition is dependent of temperature?  
[A] mass percent                      [B] mole fraction                      [C] molality  
[D] molarity                              [E] none of these.

科目：普通化學 適用：應化系二

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  
共 5 頁  
第 2 頁

編號：341

4. Rank the following 0.10 M solution in order of increasing pH: HCl, HF, NaF, NaCl.

- [A] HCl < HF < NaCl < NaF                      [B] HF < HCl < NaCl < NaF  
[C] HCl < HF < NaF < NaCl                      [D] HF < HCl < NaF < NaCl  
[E] HCl < NaCl < HF < NaF

5. Which of the following sets of quantum numbers are not allowed?

- [A]  $n = 3, l = 3, m_l = 0, m_s = -1/2$                       [B]  $n = 4, l = 3, m_l = 3, m_s = -1/2$   
[C]  $n = 4, l = 2, m_l = 1, m_s = +1/2$                       [D]  $n = 5, l = 2, m_l = -1, m_s = +1/2$   
[E]  $n = 2, l = 1, m_l = 0, m_s = -1/2$

6. Which of the following molecules would be expected to have zero dipole moment on the basis of their geometry?

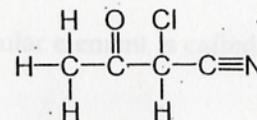
- [A] BrF<sub>5</sub>                      [B] SF<sub>4</sub>                      [C] PCl<sub>5</sub>                      [D] ClF<sub>3</sub>                      [E] XeF<sub>4</sub>

7. Consider the freezing of liquid water at -10 °C. For this process what are the signs for  $\Delta H$ ,  $\Delta S$ , and  $\Delta G$ , respectively?

- [A] - + -                      [B] + - -                      [C] - - -  
[D] + - 0                      [E] - + 0

8. What is the hybridization of the oxygen atom in the right molecule?

- [A]  $sp$                       [B]  $sp^2$                       [C]  $sp^3$   
[D]  $dsp^3$                       [E]  $d^2sp^3$



9. How many the following ligands are capable of linkage isomerism?

SCN<sup>-</sup>, N<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>, NH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub>, NO<sub>3</sub><sup>-</sup>, Cl<sup>-</sup>, H<sub>2</sub>O

- [A] 2                      [B] 4                      [C] 3                      [D] 1                      [E] 5

10. In which of the following compounds does N has its maximum oxidation state?

- [A] NH<sub>3</sub>                      [B] NO<sub>2</sub>                      [C] N<sub>2</sub>O                      [D] NO                      [E] N<sub>2</sub>O<sub>5</sub>

科目：普通化學 適用：應化系二

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；試題須隨卷撤回。

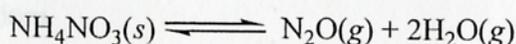
 本試題  
共 5 頁  
第 3 頁

編號：341

11. Which of the following statements is true about the octahedral complexes of  $\text{Ni}^{2+}$ ?

- [A] The strong-field complex is paramagnetic and the weak-field complex is diamagnetic
- [B] The strong-field complex is diamagnetic and the weak-field complex is paramagnetic
- [C] Both strong- and weak-field complexes are paramagnetic
- [D] Both strong- and weak-field complexes are diamagnetic
- [E] None is true

12. What is the equilibrium expression for the following reaction?



- [A]  $\frac{[\text{N}_2\text{O}][\text{H}_2\text{O}]^2}{[\text{NH}_4\text{NO}_3]}$       [B]  $\frac{[\text{N}_2\text{O}][\text{H}_2\text{O}]}{[\text{NH}_4\text{NO}_3]}$       [C]  $\frac{[\text{NH}_4\text{NO}_3]}{[\text{N}_2\text{O}][\text{H}_2\text{O}]^2}$
- [D]  $[\text{N}_2\text{O}][\text{H}_2\text{O}]^2$       [E]  $[\text{N}_2\text{O}][\text{H}_2\text{O}]$

13. Which of the following statements is false?

- [A] Every atom has three subatomic particles: proton, neutron, and electron.
- [B] Every atom has an equal number of electrons and protons, so atoms have no net electrical charge.
- [C] The number of protons in the nucleus of an atom of any particular element is called that element's atomic number.
- [D] Atoms of a given element can differ in the number of neutrons they contain and consequently in mass.
- [E] The nature of an atom is decided by the number of protons. Carbon-12 ( $^{12}\text{C}$ ) presents the carbon atom containing 12 neutrons.

14. List the following ions and atoms in order of decreasing radius:  $\text{O}^{2-}$ ,  $\text{F}^-$ ,  $\text{Ne}$ ,  $\text{Na}^+$ ,  $\text{Mg}^{2+}$ .

- [A]  $\text{F}^- > \text{O}^{2-} > \text{Ne} > \text{Mg}^{2+} > \text{Na}^+$       [B]  $\text{O}^{2-} > \text{F}^- > \text{Ne} > \text{Na}^+ > \text{Mg}^{2+}$
- [C]  $\text{Na}^+ > \text{Mg}^{2+} > \text{Ne} > \text{F}^- > \text{O}^{2-}$       [D]  $\text{Mg}^{2+} > \text{Na}^+ > \text{Ne} > \text{O}^{2-} > \text{F}^-$
- [E]  $\text{Mg}^{2+} > \text{Na}^+ > \text{Ne} > \text{F}^- > \text{O}^{2-}$

科目：普通化學 適用：應化系二

編號：341

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  
共 5 頁  
第 4 頁

15. How many of the following molecules are polar?  $\text{SF}_2$ ,  $\text{SF}_4$ ,  $\text{SF}_6$ ,  $\text{SO}_2$ ,  $\text{SO}_3$

- [A] 5            [B] 4            [C] 3            [D] 2            [E] 1

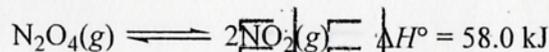
16. The rate law for the decomposition of phosphine ( $\text{PH}_3$ ) is

$$\text{Rate} = -d[\text{PH}_3]/dt = k[\text{PH}_3]$$

It takes 180. s for the concentration of 1.00 M  $\text{PH}_3$  to decrease to 0.125 M. How much time is required for 1.60 M  $\text{PH}_3$  to decrease to a concentration of 0.40 M?

- [A] 240 s            [B] 180 s            [C] 150 s            [D] 120 s            [E] 60 s

17. Consider the equilibrium



In which direction will the equilibrium shift when (i)  $\text{N}_2\text{O}_4$  is added, (ii)  $\text{NO}_2$  is moved, (iii) the total pressure is increase by addition of  $\text{N}_2(\text{g})$ , (iv) the volume is increased, (v) the temperature is decreased?

- [A] (i) right, (ii) right, (iii) no shift, (iv) right, (v) left  
 [B] (i) right, (ii) right, (iii) left, (iv) right, (v) left  
 [C] (i) left, (ii) right, (iii) no shift, (iv) left, (v) no shift  
 [D] (i) left, (ii) right, (iii) left, (iv) no shift, (v) right  
 [E] (i) right, (ii) right, (iii) no shift, (iv) left, (v) right

18. Magnesium has three isotopes,  $^{24}_{12}\text{Mg}$ ,  $^{25}_{12}\text{Mg}$ , and  $^{26}_{12}\text{Mg}$ . How many protons, neutrons, and electrons in an atom of  $^{25}_{12}\text{Mg}$ ?

- [A] 25, 25, 25            [B] 12, 13, 12            [C] 25, 12, 25  
 [D] 12, 25, 12            [E] 25, 12, 12

19. When heat is added to proteins, the hydrogen bonding in the secondary breaks apart. What are the algebraic signs of  $\Delta H$  and  $\Delta S$  for the denaturation process?

- [A]  $\Delta H$  is negative and  $\Delta S$  is positive            [B]  $\Delta H$  is positive and  $\Delta S$  is negative  
 [C]  $\Delta H$  is positive and  $\Delta S$  is 0            [D] Both  $\Delta H$  and  $\Delta S$  are negative  
 [E] Both  $\Delta H$  and  $\Delta S$  are positive

科目：普通化學 適用：應化系二

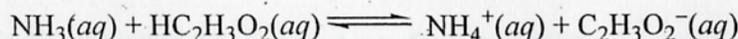
編號：341

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  
共 5 頁  
第 5 頁

20. For the reaction



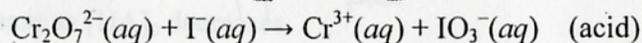
Which of the following statements is(are) true?

- (i) The  $\text{NH}_3$  is a base whereas the  $\text{HC}_2\text{H}_3\text{O}_2$  is an acid.
- (ii) The  $\text{NH}_4^+$  is a base whereas the  $\text{C}_2\text{H}_3\text{O}_2^-$  is an acid.
- (iii) There are two conjugate acid-base pairs:  $\text{NH}_3$  and  $\text{HC}_2\text{H}_3\text{O}_2$ , and  $\text{NH}_4^+$  and  $\text{C}_2\text{H}_3\text{O}_2^-$ .
- (iv) There are two conjugate acid-base pairs:  $\text{NH}_3$  and  $\text{NH}_4^+$ , and  $\text{HC}_2\text{H}_3\text{O}_2$  and  $\text{C}_2\text{H}_3\text{O}_2^-$ .

- [A] (i) and (iii)                      [B] (i) and (iv)                      [C] (ii) and (iii)  
[D] (ii) and (iv)                      [E] only (i)

三、簡答題 (28%)

1. Balance the following equation: (6%)



2. Draw a qualitative graph to show how the first property varies with the second in each of the following (assuming 1 mol of an ideal gas and  $T$  in kelvins) (6%)

- [A]  $P$  versus  $V$  with constant  $T$   
[B]  $V$  versus  $T$  with constant  $P$

3. In the periodic table, how many elements are (6%)

- [A] in the halogen group?  
[B] in the alkali family?  
[C] in the lanthanide series?

4. The following diagram shows the reaction profile of a reaction. Label the components indicated by the letters A-E. (10%)

