

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

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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.

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

[A] $\text{HCl} < \text{HF} < \text{NaCl} < \text{NaF}$ [B] $\text{HF} < \text{HCl} < \text{NaCl} < \text{NaF}$ [C] $\text{HCl} < \text{HF} < \text{NaF} < \text{NaCl}$ [D] $\text{HF} < \text{HCl} < \text{NaF} < \text{NaCl}$ [E] $\text{HCl} < \text{NaCl} < \text{HF} < \text{NaF}$

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

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

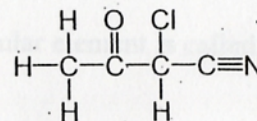
6. Which of the following molecules would be expected to have zero dipole moment on the basis of their geometry?

[A] BrF_5 [B] SF_4 [C] PCl_5 [D] ClF_3 [E] XeF_4

7. Consider the freezing of liquid water at -10°C . For this process what are the signs for ΔH , ΔS , and ΔG , 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^- , N_3^- , NO_2^- , $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$, NO_3^- , Cl^- , H_2O

[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_3 [B] NO_2 [C] N_2O [D] NO [E] N_2O_5

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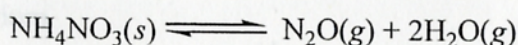
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第 3 頁

11. Which of the following statements is true about the octahedral complexes of 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}C) presents the carbon atom containing 12 neutrons.

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

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15. How many of the following molecules are polar? SF_2 , SF_4 , SF_6 , SO_2 , SO_3

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

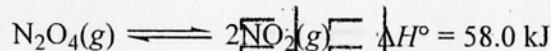
16. The rate law for the decomposition of phosphine (PH_3) is

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

It takes 180. s for the concentration of 1.00 M PH_3 to decrease to 0.125 M. How much time is required for 1.60 M 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) N_2O_4 is added, (ii) 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 ΔH and ΔS for the denaturation process?

- [A] ΔH is negative and ΔS is positive [B] ΔH is positive and ΔS is negative
 [C] ΔH is positive and ΔS is 0 [D] Both ΔH and ΔS are negative
 [E] Both ΔH and ΔS are positive

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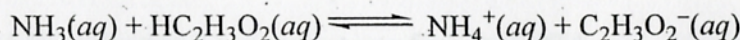
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20. For the reaction



Which of the following statements is(are) true?

- (i) The NH_3 is a base whereas the $\text{HC}_2\text{H}_3\text{O}_2$ is an acid.
- (ii) The 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: NH_3 and $\text{HC}_2\text{H}_3\text{O}_2$, and NH_4^+ and $\text{C}_2\text{H}_3\text{O}_2^-$.
- (iv) There are two conjugate acid-base pairs: NH_3 and 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)

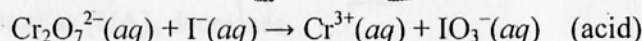
[C] (ii) and (iii)

[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%)

