靜宜大學九十九學年度碩士班暨碩士在職專班招生考試試題
系所: 應用化學系 科目: 綜合化學

Part I: General Chemistry (單一選擇題 共佔 50 分，每題 2 分，答錯不倒扣)

1. Which of the following theory can explain the Chinese fire lamp lift up to the sky?
   (a) Boyle’s law (b) Charles’s law (c) Avogadro’s law (d) Dalton’s law

2. Which of the following is not true of 98 gasoline over 95 gasoline?
   (a) more mileage (b) more expensive (c) good for sport car (d) different compounds

3. Which of the following compound is used in the normal instant heat pack?
   (a) H₂O (b) CH₃COOH (c) HCl (d) Fe powder

4. If a atom is a size of baseball field, the electron is about the size of ?
   (a) door (b) man (c) ball (d) rice

5. Which of the following quantum numbers is correct for 3d² orbital electron?
   (a) n=2, l=3, m_l=0 (b) n=3, l=2, m_l=5 (c) n=3, l=1, m_l=3 (d) n=3, l=1, m_l=1

6. Which of the following quantum number will decide the energy of electron orbital?
   (a) n (b) l (c) m_l (d) m_s

7. Which of the following would you expect to exhibit the lowest magnetism?
   (a) K atom (b) Ti²⁺ ion (c) Fe²⁺ ion (d) Fe³⁺ ion

8. Which of the following element can react with Xe gas to form noble gas compound?
   (a) Li (b) F (c) Cl (d) Cs

9. Which of the following element can glow in the dark?
   (a) Cl (b) C (c) Cr (d) P

10. Which of the following element is used as a coin material?
    (a) Cl (b) Pd (c) Cs (d) Ni

11. Which of the following element is the future energy source?
    (a) Cl (b) Ca (c) He (d) H

12. Which of the following element is used as explosive reagents?
    (a) Cl (b) C (c) Cr (d) N

13. Under which condition will reaction occur spontaneously?
    (a) ΔH<0 (b) ΔS>0 (c) ΔG>0 (d) ΔG<0

14. Which is the electron configuration of Cr element?
    (a) [Ar]4S²3d⁸ (b) [Ar]4S²3P⁴ (c) [Ar]4S²3P⁵ (d) [Ar]4S¹3d⁵
15. Examine the titration curve shown below. Which of the following titration could be presented?
(a) HCl by NaOH  (b) NH₃ by HCl  (c) NH₃ by H₂SO₄  (d) H₂SO₄ by NaOH

16. Following the previous equation, which is the most possible pH at the equivalence point?
(a) 8  (b) 7  (c) 5  (d) 4

17. Following the previous equation, which is the best pH indicator at the equivalence point?
(a) Phenolphthalein  (b) Methyl red  (c) Phenol red  (d) Methyl orange

18. How many unpaired electrons for [Ni(CN)₄]²⁻ complex?
(a) 0  (b) 1  (c) 2  (d) 3

19. Methane burns in oxygen to yield carbon dioxide and water. Use the following information to calculate ΔH° (in kilojoules) for the combustion of methane.
(a) -899 kJ  (b) -855 kJ  (c) -615 kJ  (d) -362 kJ

\[
\begin{align*}
\text{CH}_4(g) + O_2(g) & \rightarrow \text{CH}_2\text{O}(g) + \text{H}_2\text{O}(g) & \Delta H^\circ &= -284 \text{ kJ} \\
\text{CH}_2\text{O}(g) + O_2(g) & \rightarrow \text{CO}_2(g) + \text{H}_2\text{O}(g) & \Delta H^\circ &= -518 \text{ kJ} \\
\text{H}_2\text{O}(l) & \rightarrow \text{H}_2\text{O}(g) & \Delta H^\circ &= 44.0 \text{ kJ}
\end{align*}
\]

20. How many are Cl⁻ anions in BaCl₂ unit cell?
(a) 2  (b) 4  (c) 6  (d) 8

21. Which is the value of the rate constant of the reaction of NH₄⁺ and NO₂⁻ by the data listed below?
(a) \(6.0 \times 10^{-4} \text{ M}^{-1}\text{s}^{-1}\)  (b) \(3.0 \times 10^{-4} \text{ M}^{-1}\text{s}^{-1}\)  (c) \(3.0 \times 10^{-3} \text{ M}^{-1}\text{s}^{-1}\)  (d) \(1.5 \times 10^{-4} \text{ M}^{-1}\text{s}^{-1}\)

\[
\text{NH}_4^+(aq) + \text{NO}_2^-(aq) \rightarrow \text{N}_2(g) + 2 \text{H}_2\text{O}(l)
\]

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Initial [NH₄⁺]</th>
<th>Initial [NO₂⁻]</th>
<th>Initial rate of consumption of NH₄⁺ (M/s)</th>
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<tbody>
<tr>
<td>1</td>
<td>0.24</td>
<td>0.10</td>
<td>(7.2 \times 10^{-6})</td>
</tr>
<tr>
<td>2</td>
<td>0.12</td>
<td>0.10</td>
<td>(3.6 \times 10^{-6})</td>
</tr>
<tr>
<td>3</td>
<td>0.12</td>
<td>0.15</td>
<td>(5.4 \times 10^{-6})</td>
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22. Which is the molecular shape of SF₄?
   (a) Tetrahedral (b) square planer (c) seesaw (d) trigonal pyramidal

23. Which one has largest ionization energy?
   (a) Mg²⁺ (b) Al³⁺ (c) Si³⁺ (d) Mg³⁺

24. Using the Following data to find the activation energy for the reaction
   \[ 2 \text{HI(g)} \rightarrow \text{H₂(g)} + \text{I₂(g)} \]
   (a) 380 kJ/mol (b) 190 kJ/mol (c) 160 kJ/mol (d) 240 kJ/mol

<table>
<thead>
<tr>
<th>Temperature(°C)</th>
<th>k(M⁻¹s⁻¹)</th>
<th>Temperature(°C)</th>
<th>k(M⁻¹s⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>283</td>
<td>3.52 x 10⁻⁷</td>
<td>427</td>
<td>1.16 x 10⁻³</td>
</tr>
<tr>
<td>356</td>
<td>3.02 x 10⁻⁵</td>
<td>508</td>
<td>3.95 x 10⁻²</td>
</tr>
<tr>
<td>393</td>
<td>2.19 x 10⁻⁴</td>
<td></td>
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25. Which compound does have highest boiling point?
   (a) CH₃CH₂CH₃ (b) CH₃OCH₃ (c) CH₃Cl (d) CH₃CN

Part II: Inorganic Chemistry; Total = 25 points

1. Define the Arrhenius-Ostwald, Brønsted-Lowry and Lewis theory. 9%

2. Which is larger: 10%  
   a. K⁺ or Cs⁺  b. La⁺⁺ or Lu⁺⁺  c. Cl⁻ or Br⁻  d. Ca²⁺ or Zn²⁺  e. Cs or Fr

3. Draw the molecular orbital of CO₂. 6%

Part III: Physical Chemistry; Total = 25 points

1. Explain the following terms (10%)
   a. Ideal solution
   b. Second law of thermodynamics
   c. Mean free path
   d. Definition of entropy
   e. Uncertainty principle

2. A sample of 2.0 mol N₂ is originally confined in 20 L at 200 K and undergo adiabatic expansion against a constant pressure of 500 torr until the volume has increased to 40 L. Calculated the ΔU and q = ? (10%).

3. Draw a P-T phase diagram of pure H₂O. (5%)