

編號： 26 系所： 化工系、材料系、環工系、地科系 科目：普通化學

說明：答案一律寫在答案卷上；請依序作答，並標明題號。

一、選擇題（單選題，每題 3 分；答錯倒扣 1 分）

- The shell number is equal to the principal quantum number. How many total electrons can shell 5 hold?
 - 30
 - 52
 - 50
 - 32
- Heat is released during a particular process. This means that:
 - The process is spontaneous under all condition.
 - $\Delta S_{\text{surr}} > 0$
 - The process tends to be spontaneous.
 - $\Delta S_{\text{sys}} > 0$
- Which one of the following ion pairs would exhibit the greatest polarity?
 - Na^+F^-
 - Cs^+F^-
 - Li^+F^-
 - K^+F^-
- What shape does a molecule that possesses a V.S.E.P.R formula of XeF_4 have?
 - square planar
 - octahedral
 - tetrahedral
 - trigonal bipyramid
- To determine whether the data available corresponds to a second order rate expression, a plot of what variables will yield a straight line?
 - $[\text{A}]$ vs $1/t$
 - $1/[\text{A}]$ vs t
 - $[\text{A}]$ vs t
 - $\ln[\text{A}]$ vs t
- One of the following changes has no effect on the position of equilibrium.
 - concentration change
 - volume change
 - temperature change
 - addition of catalyst
- For the reaction, $2\text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{OH}^-(aq)$, the value of K_w is 1×10^{-14} at 60°C . Which of the following statements is true?
 - This reaction is exothermic.
 - The $[\text{H}^+]$ is $3 \times 10^{-7} M$
 - The reaction system is acidic
 - The $[\text{OH}^-]$ is $1.333 \times 10^{-7} M$
- You wish to prepare a solution with a $\text{pH} = 5.00$. You have at your disposal NaF and HF . What must the base to acid ratio be in order to achieve this pH ? $K_a = 7.2 \times 10^{-4}$.
 - 62.0 : 1
 - 72.0 : 1
 - 70.0 : 1
 - 60.0 : 1
- For this balanced equation, $[\text{Cu}(\text{NH}_3)_4]^{2+} + [\text{S}_2\text{O}_4]^{2-} + 2\text{H}_2\text{O} \rightarrow \text{Cu} + 2[\text{SO}_3]^{2-} + 4[\text{NH}_4]^+$, determine the number of electrons gained and lost, per atom, by the oxidizing and reducing elements, respectively.
 - 1 and 1
 - 2 and 2
 - 2 and 1
 - 2 and 4
- In a nickel-cadmium battery, which one of the following reactions is occurring at the cathode?
 - $\text{Cd}(s) + 2\text{OH}^- \rightarrow \text{Cd}(\text{OH})_2 + 2e^-$
 - $\text{NiO}_2(s) + 2\text{H}_2\text{O} + 2e^- \rightarrow \text{Ni}(\text{OH})_2(s) + 2\text{OH}^-$
 - $\text{Cd}(\text{OH})_2 + 2e^- \rightarrow \text{Cd}(s) + 2\text{OH}^-$
 - $\text{Ni}(\text{OH})_2(s) + 2\text{OH}^- \rightarrow \text{NiO}_2(s) + 2\text{H}_2\text{O} + 2e^-$
- A four-coordinated complex ion, capable of geometrical isomerization, must have which one of the following hybridizations?
 - sp^3
 - sp^3d^2
 - dsp^2
 - dsp
- If a complex ion is square planar, which d-orbital is highest in energy?
 - $d_{x^2-y^2}$
 - d_{z^2}
 - d_{xy}
 - d_{yz}
- Which one of the following is a fusion reaction?
 - ${}^3\text{He} + {}^4\text{He} \rightarrow {}^7\text{Be} + \gamma$
 - ${}^{13}\text{N} \rightarrow {}^{13}\text{C} + \beta^+$
 - ${}^{28}\text{Mg} \rightarrow {}^{28}\text{Al} + \beta^-$
 - ${}^{15}\text{O} \rightarrow {}^{13}\text{N} + \beta^+$
- Which one of the following groups of elements shows ferromagnetic properties?
 - Fe, Co, Ni
 - Mn, Ti, Zn
 - Fe, V, Mn
 - Co, Cu, Zn

(背面仍有題目,請繼續作答)

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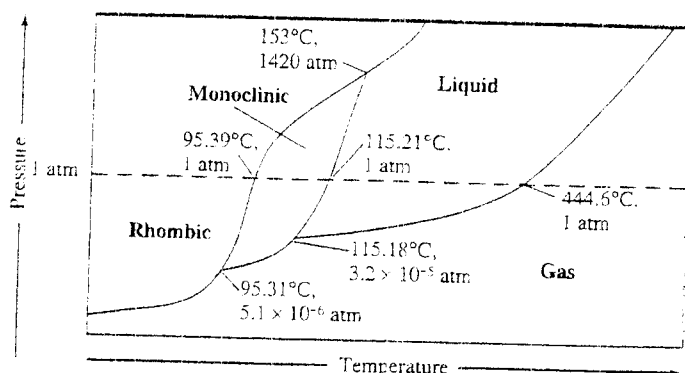
15. The compound MnO_2 is found to be stable in the presence of HNO_3 . MnO_2 readily dissolves in HCl . Which statement best explains this behavior?
- a. the nitrate ion cannot oxidize MnO_2 . b. MnO_2 cannot oxidize the nitrate.
c. the Cl^- reduces Mn from 4^+ to 2^+ d. basic MnO_2 is neutralized by HCl .
16. When ethane is converted to ethylene, the carbon atoms
- a. act as oxidizing agents b. are reduced
c. are oxidized d. are unchanged in oxidation number
17. How many structure isomers does C_4H_8 have?
- a. 6 b. 4 c. 5 d. 7
18. Electron capture process results in:
- a. Higher proton/neutron ratio b. Smaller proton/neutron ratio
c. Same proton/neutron ratio d. Smaller neutron/proton ratio
19. Place the following in order of increasing size: Ne , B^{3+} , O^{2-} , and Be^{2+}
- a. $\text{B}^{3+} < \text{Be}^{2+} < \text{Ne} < \text{O}^{2-}$ b. $\text{O}^{2-} < \text{Ne} < \text{Be}^{2+} < \text{B}^{3+}$
c. $\text{Ne} < \text{B}^{3+} < \text{Be}^{2+} < \text{O}^{2-}$ d. $\text{Ne} < \text{O}^{2-} < \text{B}^{3+} < \text{Be}^{2+}$
20. The value of K_{eq} goes down by a factor of 100 at room temperature. What is the change in ΔG° in kJ for the reaction.
- a. 1.37 b. 11.41 c. 0.382 d. -11.41

二、計算與問答題

1. The reaction, $\text{A} \rightarrow \text{B} + \text{C}$, is known to be zero order in A, and to have a rate constant of $5.0 \times 10^{-2} \text{ molL}^{-1}\text{s}^{-1}$ at 25°C . An experiment was run at 25°C where $[\text{A}^0] = 1.00 \times 10^{-3} \text{ M}$. Please answer the followings. (9 分)
- a. Write the integrated rate law for this reaction.
b. Calculate the half-life for the reaction.
c. Calculate the concentration of B after $5.0 \times 10^{-3} \text{ s}$ has passed.
2. For the species O_2 , O_2^+ , and O_2^- , give the electron configuration and the bond order for each. Which has the strongest bond? (10 分)
3. At what temperature is the following process spontaneous at 1 atm? (3 分)
- $$\text{Br}_2(\text{l}) \rightarrow \text{Br}_2(\text{g})$$
- where $\Delta H^\circ = 31.0 \text{ kJ/mol}$ and $\Delta S^\circ = 93.0 \text{ J K}^{-1} \text{ mol}^{-1}$
What is the normal boiling point of liquid Br_2 ? (4 分)

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4. Use the following phase diagram for sulfur to answer the following questions.



- What phases are in equilibrium at each of the triple points? (3 分)
 - What are the normal melting point and normal boiling point of sulfur? (2 分)
 - Which is the denser solid phase, monoclinic or rhombic sulfur? (3 分)
5. Both phenol and ethyl alcohol have $-\text{OH}$ group. Which one is more acidic? Account for your answer. (5 分)