

- 注意事項： 1. 答案一律寫在試卷上，否則不予計分。
2. 請標明題號依序作答，不必抄題。
3. 試題應隨同試卷繳回，不得攜出試場。

- Write chemical formula for the following: (8%)
 - barium nitrite
 - nitrogen pentoxide
 - benzoic acid
 - potassium hexacyanoferrate (II)
- Predict the hybridization of the central atom and draw the geometry for each of the following species: (8%)
 - BrF_3
 - SF_4
 - SO_3^{2-}
 - ICl_4^-
- Choose and explain: (20%)
 - larger dipole moment: NH_3 or NF_3
 - stronger Lewis base: $(\text{CH}_3)_2\text{S}$ or $(\text{CF}_3)_2\text{S}$
 - higher critical temperature: CO_2 or SO_2
 - larger bond angle: NO_2^- or O_3
- Hydrogen peroxide can function either as an oxidizing agent or as a reducing agent. Write half-reaction for H_2O_2 acting in this roles. (6%)
- CCl_4 and SiCl_4 both exist as nonpolar liquids. When CCl_4 is added to water, distinct layers form. When SiCl_4 is added to water, a violent reaction occurs.

$$\text{SiCl}_4(l) + 2\text{H}_2\text{O}(l) \longrightarrow \text{SiO}_2(s) + 4\text{HCl}(aq)$$
 Explain why SiCl_4 is so much more reactive toward H_2O than CCl_4 . (6%)
- (a) How does crystal field theory (CFT) account for the colors of complex ion? (4%)
(b) Explain why compounds of copper (II) are generally colored, but compounds of copper (I) are not. (4%)
- Gold crystallizes in a cubic closest-packed structure. If the Au atom has an atomic radius of 1.44Å, what is the length of the unit cell edge in Au? (6%)
- Arrange the following species in order of increasing bond energy: O_2 , O_2' , O_2^- . Which of these is paramagnetic? Explain your answers by drawing an energy level diagram showing the electronic configuration of each of these species. (8%)
- Calculate the pH of a solution that contains 1.00M HCN ($K_a=6.2 \times 10^{-10}$) and 5.00M HNO_2 ($K_a=4.0 \times 10^{-4}$). Also calculate the $[\text{CN}^-]$ in this solution at equilibrium. ($\log 4=0.6$, $\log 5=0.7$, $\log 6=0.8$) (8%)

10. A solution is made up to contain $[Cd^{2+}] = 0.40M$ and $[H_3O^+] = 0.10M$. Then the solution was treated with H_2S until it was saturated ($[H_2S] = 0.1M$). If $K_{sp} = 3.6 \times 10^{-29}$ for CdS , what concentration of Cd^{2+} remains at equilibrium? (8%)

11. Consider the following reaction:



Will the equilibrium constant for this reaction at 300K be greater than, less than, or equal to the equilibrium constant at 400K?

Explain your answer. (6%)

12. When 2.00 mol of $SO_2(g)$ react completely with 1.00 mol of $O_2(g)$ to form 2.00 mol of $SO_3(g)$ at $25^\circ C$ and a constant pressure of 1.00 atm, 198 KJ of energy are released as heat. Calculate ΔH and ΔE for this process. ($R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$) (8%)