

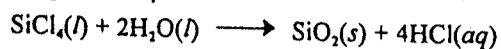
- 注意事項： 1. 答案一律寫在試卷上，否則不予計分。
2. 請標明題號依序作答，不必抄題。
3. 試題應隨同試卷繳回，不得攜出試場。

※ 1-10 題每題 3 分

- What hybridization is predicted for the sulfur atom in the SO_3^{2-} ion?
 - sp^2
 - sp^3
 - sp^3d
 - sp^3d^2
 - none of these
- The dihydrogenphosphate ion, H_2PO_4^- , has both a conjugate acid and a conjugate base. These are, respectively:
 - H_3PO_4 , PO_4^{3-}
 - H_3PO_4 , HPO_4^{2-}
 - H_2PO_4^- , HPO_4^{2-}
 - HPO_4^{2-} , PO_4^{3-}
 - HPO_4^{2-} , H_3PO_4
- How does the pH of a 0.20 M solution of NaHCO_3 compare to that of a 0.10 M solution of NaHCO_3 ?
 - It is 2 times as high.
 - It is half as much.
 - It is the same.
 - cannot be determined with the K_a values
 - none of these
- A salt solution sits in an open beaker. Assuming constant temperature and pressure, the vapor pressure of the solution
 - increases over time.
 - decreases over time.
 - stays the same over time.
 - Need to know which salt is in the solution to answer this.
 - Need to know the temperature and pressure to answer this.
- F_2 is a better oxidizing agent than Cl_2 in the gas phase principally because:
 - F_2 has a weaker bond than Cl_2 .
 - F_2 has a stronger bond than Cl_2 .
 - the electron affinity of F is greater than that of Cl.
 - the electronegativity of Cl is greater than that of F.
 - the ionization energy for F is greater than that for Cl.
- A material is made from Al, Ga, and As. The mole fraction of each element is 0.25, 0.26, and 0.49, respectively. This material would be
 - a metallic conductor because Al is present.
 - an insulator.
 - a p-type semiconductor.
 - an n-type semiconductor.
- For a reaction in a voltaic cell both ΔH° and ΔS° are positive. Which of the following statements is true?
 - E°_{cell} will increase with an increase in temperature.
 - E°_{cell} will decrease with an increase in temperature.
 - E°_{cell} will not change when the temperature increases.
 - $\Delta G^\circ > 0$ for all temperatures.
 - None of the above statements is true.
- Which of the following statements is true about the octahedral complexes of Ni^{2+} ?
 - Both strong- and weak-field complexes are diamagnetic.
 - The strong-field complex is diamagnetic and the weak-field complex is paramagnetic.
 - The strong-field complex is paramagnetic and the weak-field complex is diamagnetic.
 - Both strong- and weak-field complexes are paramagnetic.
- Which of the following functional groups does not contain a doubly bonded oxygen?
 - aldehyde
 - carboxyl
 - ketone
 - carboxylic acid
 - all contain a double bond
- Which of the following is optically active (i.e., chiral)?
 - $\text{HN}(\text{CH}_3)_2$
 - CH_2Cl_2
 - 2-chloropropane
 - 2-chlorobutane
 - 3-chloropentane

(背面仍有題目,請繼續作答)

11. The compounds CCl_4 and H_2O do not react with each other. On the other hand, silicon tetrachloride reacts with water according to the equation



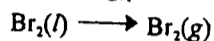
Discuss the reactivity of water with SiCl_4 as compared with its lack of reactivity with CCl_4 . (8%)

12. Calculate the $[\text{Zn}^{2+}]$ and $[\text{C}_2\text{O}_4^{2-}]$ remaining in solution after 15.00 mL of 0.120 F $\text{Zn}(\text{NO}_3)_2$ are mixed with 10.00 mL of 0.100 F $\text{Na}_2\text{C}_2\text{O}_4$. The K_{sp} of ZnC_2O_4 is 2.5×10^{-9} . (8%)

13. Solutions of sodium thiosulfate are used to dissolve unexposed AgBr in the developing process for black-and-white film. What mass of AgBr can dissolve in 1.00 L of 0.500 M $\text{Na}_2\text{S}_2\text{O}_3$? Assume the overall formation constant for $\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}$ is 2.9×10^{13} and K_{sp} for AgBr is 5.0×10^{-13} . (formula weight of $\text{AgBr} = 187.8\text{g}$) (8%)

14. One mole of an ideal gas is expanded reversibly from an initial pressure of 6.00 atm to a final pressure of 0.500 atm. The temperature is kept constant at 20 °C. Calculate ΔE , ΔH , ΔS , ΔG , q , and w for this process. (10%)

15. At what temperature is the following process spontaneous at 1 atm?



$$\Delta H^\circ = 31.0 \text{ kJ/mol} \quad \text{and} \quad \Delta S^\circ = 93.0 \text{ J/K}\cdot\text{mol}$$

What is the normal boiling point of liquid Br_2 ? (6%)

16. The decomposition of NH_3 to N_2 and H_2 was studied on two surfaces:

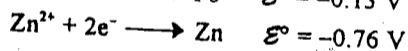
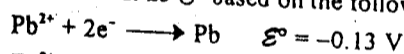
Surface	E_a (kJ/mol)
W	163
Os	197

Without a catalyst the activation energy is 335 kJ/mol.

(a) Which surface is the better heterogeneous catalyst for the decomposition of NH_3 ? Why? (2%)

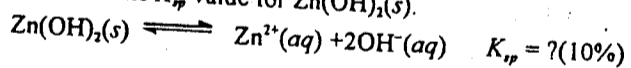
(b) How many times faster is the reaction at 298 K on the W surface compared with the reaction with no catalyst present? (8%)

17. Consider the standard cell at 25 °C based on the following half-reaction:



To the standard cell, OH^- is added to the zinc compartment, causing precipitation of $\text{Zn}(\text{OH})_2(s)$. After precipitation is complete, the concentration of OH^- is 0.10 M and the measured cell potential is 1.05 V.

Calculate the K_{sp} value for $\text{Zn}(\text{OH})_2(s)$.



18. The compound $\text{Ni}(\text{H}_2\text{O})_6\text{Cl}_2$ is green, while $\text{Ni}(\text{NH}_3)_6\text{Cl}_2$ is purple. Predict the predominant color of light absorbed by each compound. Which compound absorbs light with the shorter wavelength? Predict in which compound Δ is greater and whether H_2O or NH_3 is a stronger field ligand. (10%)