國立中央大學八十九學年度轉學生入學試題卷

18 生命科學系 二年級 科目：普通化學 共 / 頁 第 / 頁

1. Hydrogen cyanide (HCN) is prepared commercially by the reaction of methane, $CH_4(g)$, ammonia, $NH_3(g)$, and oxygen, $O_2(g)$, at high temperature. The other product is gaseous water.
   (a) Write a chemical equation for the reaction. (5 points)
   (b) What volume of HCN(g) can be obtained from 20.0 L $CH_4(g)$, 20.0 L $NH_3(g)$, and 20.0 L $O_2(g)$? The volumes of all gases are measured at the same temperature and pressure. (5 points)

2. Combustion of table sugar produces $CO_2(g)$ and $H_2O(l)$. When 1.46 g of table sugar is combusted in a constant volume (bomb) calorimeter, 24.0 kJ of heat is liberated.
   (a) Assuming that table sugar is pure sucrose, $C_{12}H_{22}O_{11}(s)$, write the balanced equation for the combustion reaction. (4 points)
   (b) Calculate ΔE for the combustion reaction of sugar. (3 points)
   (c) Calculate ΔH for the combustion reaction of sugar. (3 points)

3. You have the following reagents on hand:

Solids (pK_a of acid form is given)	solutions
Benzoic acid (4.9)	5.0 M HCl
Sodium acetate (4.74)	1.0 M acetic acid
Potassium fluoride (3.14)	2.6 M NaOH
Ammonium chloride (9.26)	1.0 M HOCl (7.46)

   What combinations of reagents would you use to prepare buffers at the following pH values?
   (a) 3.0 (b) 7.0 (c) 5.0 (d) 9.0 (10 points)

4. Compare the relative stability of the following species and calculate their bond order, indicate their magnetic property (that is paramagnetic or diamagnetic): O_2, O_2^+, O_2^-, O_2^{2-}. (10 points).

5. Write Lewis structures that obey the octet rule for the following species. Assign the formal charge for each atom.
   (a) $POCl_3$ (4 points) (b) SO_2Cl_2 (3 points)
   (c) NO_4^{3-} (3 points).

6. Name five petrochemicals and their usage. (10 points)

7. What are coordination complexes? Why the coordination complexes are so important in biology system? (10 points)

8. The reaction

$$I^-(aq) + OCl^-(aq) \longrightarrow IO^-(aq) + Cl^-(aq)$$

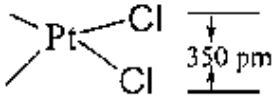
was studied and the following data were obtained:

$[I^-]_o$ (mol/L)	$[OCl^-]_o$ (mol/L)	Initial Rate (mol/L. s)
0.12	0.18	7.91×10^{-2}
0.06	0.18	3.95×10^{-2}
0.03	0.090	9.88×10^{-3}
0.24	0.090	7.91×10^{-2}

   (a) What is the rate law? (5 points)
   (b) Calculated the rate constant. (5 points)

9. (a) Each human DNA molecule contains roughly 5×10^9 base pairs. The spacing between base pairs along a given chains is 340 pm. If a single human DNA molecule was stretched to its full length, how long would it be? (5 points)

   (b) The compound cis-platin appears to kill cancer cells by inhibiting DNA synthesis. Given the following structural information about cis-platin,



cis-platin

   information form (a), and the fact that the chloride ion is easily displaced by other donor molecules in cis-platin, speculate on how cis-platin may interact with DNA. (5 points)

10. What reaction will take place at the cathode and the anode when each of the following is electrolyzed?
    (a) Molten KF (3 points)
    (b) 1.0 M KF solution (3 points)
    (c) 1.0 M H_2O_2 solution containing 1.0 M HCl (4 points)

參考用