系所組別：地科系、生科系、化工系、材料系、環工系

考試科目：普通化學　　考試日期：0714，節次：1

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一、選擇題: (30 %，每題 3 分)

1. Consider a reaction in which two reactants make one product (for example, consider the unbalanced

   A + B → C). You know the following:

   2.0 mol A (with an excess of B) can make a maximum of 2.0 mol C

   3.0 mol B (with an excess of A) can make a maximum of 4.0 mol C

   If you react 2.0 mol A and 3.0 mol B, what is the maximum amount of C that can be produced?

   (A) 2.0 mol ; (B) 4.0 mol ; (C) 5.0 mol ; (D) 6.0 mol ; (E) More information is needed.

2. Which of the following pairs of substances could form polyester?

   (A) $H_2C{=}CHCH_3 + CH_3CH_2CH_2COOH$; (B) $HOOC(CH_2)_4COOH + H_2NCH_2CH{=}CHCH_3$

   (C) $H_2C{=}CHCN + H_2C{=}CHCH_3$; (D) $HOCH_2CH_2OH + HOOCCH_2COOH$

   (E) $H_2NCH_2COOH + H_2NCH_2CH_2COOH$

3. Which types of processes are likely when the neutron-to-proton ratio in a nucleus is too large?

   I. α decay ; II. β decay ; III. positron production; IV. electron capture

   (A) I, II ; (B) II, III ; (C) III, IV ; (D) II only ; (E) IV only.

4. How many unpaired electrons are found in $MnCl_4^{2-}$ (tetrahedral)? (Mn: [Ar] $4s^2 3d^5$)

   (A) 0 ; (B) 1 ; (C) 2 ; (D)4 ; (E) 5

5. Choose the correct molecular structure for NO_3^-.

   (A) trigonal bipyramidal ; (B) trigonal planar ; (C) tetrahedral ; (D) octahedral ; (E) None of these

6. Which of the following molecules does *not* have a dipole moment?

   (A) H_2S ; (B) H_2O ; (C) H_2Xe ; (D) All of these have a dipole moment. ;

   (E) None of these has a dipole moment

7. How many electrons can be described by the quantum numbers $n = 4$, $l = 3$, $m_l = -1$, $m_s = -1$?

   (A) 0 ; (B) 2 ; (C) 6 ; (D) 8 ; (E) 12

8. The solubility of AgCl in water is _____ the solubility of AgCl in strong acid at the same temperature.

   (A) greater than ; (B) about the same as ; (C) less than ; (D) cannot be determined

9. How many of the following gases at STP are less dense than air at STP?

   NH_3, He, Kr, and F_2

   (A) 0 ; (B) 1 ; (C) 2 ; (D) 3 ; (E) 4

續下頁

系所組別：地科系、生科系、化工系、材料系、環工系

考試科目：普通化學 考試日期：0714，節次：1

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

10. For the hypothetical reactions (1) and (2), $K_1 = 10^2$ and $K_2 = 10^{-4}$.

(1) $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$

(2) $2A_2(g) + C_2(g) \rightleftharpoons 2A_2C(g)$

(3) $A_2C(g) + B_2(g) \rightleftharpoons 2AB(g) + (1/2)C_2(g)$

What is the value for K for reaction 3?

(A) 10^{-2} ; (B) 10^4 ; (C) 10^6 ; (D) 10^2 ; (E) 10^{-4}

二、問答與計算題 (70 %；計算與問答題需寫過程否則不予計分)

1. (a) Please provide a simple method to distinguish the strong electrolyte solution, weak electrolyte solution and non-electrolyte solution. (5 %)

(b) Briefly describe how to obtain the electron mass in the past century. (5 %)

2. (a) The conversion of solid carbon from graphite form to its diamond form (i.e. $C_{graphite}(s) \rightarrow C_{diamond}(s)$) is very difficult to be measured in a calorimeter (卡計). Now, you are an excellent chemistry. Please provide a simple method to measure the ΔH of this reaction. (Hint: Hess's law)) (6 %)

(b) Illustrate four gases which can lead to the "greenhouse effect". (4 %)

3. (a) Justify: ΔG = maximum of the useful work at constant pressure and temperature (5%);

(b) Simply describe the Second Law of Thermodynamics? (3 %)

(c). Calculate the entropy of a perfect crystal at T = 0 K. (2 %)

4. Use the molecular orbital model and draw MO energy-level diagrams to predict the magnetism and bond order of C_2 molecule and O_2^{2+} ion. (10 %)

5. (a) What is the principal driving force for the rule "like dissolves like."? (3 %)

(b) Based on the thermodynamic concept, please briefly describe why the non-polar molecules do not have a tendency to dissolve in water. (4 %)

(c) Use the Henry's law to explain the fizzing(冒泡泡) when opening a can of soda. (3%)

6. (a) Briefly describe how to get the activation energy of a reaction. (3 %)

(b) Derive the integrated rate law of the **second-order reaction**. (5 %)

(c) Draw a **concentration vs. time** plot for a **zero-order** reaction. (2 %)

7. (a) How to get the lattice size of a crystal. (3 %)

(b) Please briefly describe how to get the ΔH_{vap} of a liquid from vapor pressure at different temperature. (4 %)

(c) Draw the phase diagram of water, in which including the T_3 (triple point) and T_c (critical temperature) points. (3 %)

本試題結束