

國立成功大學
110學年度碩士班招生考試試題

編 號： 51

系 所： 地球科學系

科 目： 普通化學

日 期： 0203

節 次： 第 2 節

備 註： 不可使用計算機

※ 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：(40%，每題 2 分)

1. The equilibrium constant for the reaction $B^- + H^+ \leftrightarrow HB$ is called:
(A) K_a (B) K_b (C) $1/K_a$ (D) K_w/K_b (E) $1/K_b$
2. Which of the following have a -C-O-C- functional group?
(A) ethers (B) alcohols (C) amines (D) aldehydes (E) ketones
3. The number of half-lives needed for a radioactive element to decay to one-eighth of its original activity is (choose nearest number):
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5
4. Which one of the following is the strongest intermolecular force experienced by Noble gases?
(A) Dipole-ion interactions (B) Dipole-dipole interactions (C) Hydrogen bonding interactions
(D) Ion-ion interactions (E) London dispersion forces
5. In which of the following physical processes will energy be released as heat?
(A) sublimation (B) crystallization (C) vaporization (D) melting (E) none of them
6. What is the hybridization of S in the molecule H_2S ?
(A) sp (B) sp^2 (C) sp^3 (D) dsp^3 (E) d^2sp^3
7. Which of the following is paramagnetic?
(A) B_2 (B) C_2 (C) H_2 (D) N_2 (E) F_2
8. The equilibrium constant for $A + B \leftrightarrow C$ is 2.0×10^{-6} .
Determine the equilibrium constant for $2A + 2B \leftrightarrow 2C$.
(A) 2.0×10^{-6} (B) 4.0×10^{-12} (C) 2.0×10^{-12} (D) 5.0×10^5 (E) 2.5×10^{11}
9. How many electrons can be described by the quantum numbers $n = 3, l = 4, m_l = 0$?
(A) 8 (B) 16 (C) 4 (D) 2 (E) 0
10. Which of the following is not an oxidation-reduction reaction?
(A) A reaction in which a metal reacts with a nonmetal (B) A combustion reaction
(C) A precipitation reaction (D) A metal reacting with an acid (E) Corrosion of a metal

11. Consider the unbalanced equation $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$
For every 1.0 mol of C_4H_{10} , ___ mol of O_2 is required.
(A) 1.0 (B) 6.5 (C) 4 (D) 13 (E) 8
12. Which pair of ions would *not* be expected to form a precipitate when dilute solutions of each are mixed?
(A) Al^{3+} , S^{2-} (B) Ag^+ , Cl^- (C) Ni^{2+} , SO_4^{2-} (D) Mn^{2+} , OH^- (E) Co^{2+} , PO_4^{3-}
13. For which gas do the molecules have the highest average velocity at constant temperature?
(A) He (B) CH_4 (C) NH_3 (D) H_2
(E) The molecules of all the gases have the same average velocity.
14. When 1 mole of a nonvolatile solvent-nondissociating substance is dissolved in 3 mole of solvent, the ratio of vapor pressure of the solution to that of the pure solvent (at the same temperature) is approximately
(A) 1/3 (B) 2/3 (C) 1/4 (D) 3/4 (E) none of these
15. How many oxides of carbon are there?
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5
16. Which of the following complexes shows geometric isomerism?
(A) $[Co(H_2O)_5Br]SO_4$ (B) $[Co(H_2O)_6]Br_3$ (C) $[Co(H_2O)_5Cl]Cl_2$
(D) $K[Co(H_2O)_2Cl_4]$ (E) $Na_3[CoCl_6]$
17. The stable nuclide $^{206}_{82}Pb$ is formed from $^{238}_{92}U$ by a long series of α and β decays. Which of the following nuclides could *not* be involved in this decay series?
(A) Pa-234 (B) Pu-239 (C) Po-221 (D) Tl-210 (E) Ra-226
18. When heat is added to proteins, the hydrogen bonding in the secondary structure breaks apart. What are the algebraic signs of ΔH and ΔS for the denaturation process?
(A) Both ΔH and ΔS are positive (B) Both ΔH and ΔS are negative (C) ΔH is positive and ΔS is negative
(D) ΔH is negative and ΔS is positive (E) ΔH is positive and ΔS is 0
19. The pH at the equivalence point at 25°C of a titration of a weak acid with a strong base is
(A) less than 7.00 (B) equal to 8.00 (C) equal to 7.00 (D) greater than 7.00
(E) More data are needed to answer this question

20. Atoms having greatly differing electronegativities are expected to form
- (A) hydrogen bonds (B) polar covalent bonds (C) nonpolar covalent bonds
(D) ionic bonds (E) covalent bonds

二、問答與計算題 (60 % ; 計算題需寫過程否則不予計分)

1. (a). Write down an equation to define each of the following thermodynamic property;
- (1). Enthalpy (H) (2). Free energy (G) (4 %)
- (b). Write down the Boltzmann's definition of entropy. (2 %)
- (c). Calculate the entropy of a perfect crystal at $T = 0$ K. (2 %).
- (d). Justify: $\Delta G = \text{maximum of } W_{\text{useful}}$ (6 %)
2. (a) Write down the de Broglie's equation. (2 %)
- (b) Please give the form of Schrödinger equation. (2 %)
- (c) Give the Heisenberg uncertainty principle. (2 %)
- (d) Please derive an equation for the energies of a particle freely moving in a box.
(Length of the box = L ; mass of the particle = m). (4 %)
3. Use the molecular orbital model to draw MO energy-level diagrams for predicting the magnetism and bond order of NO molecule. (8 %) (Atomic number: $N = 7$; $O = 8$)
4. (a) Please write down the Arrhenius equation. (2 %)
- (b) Briefly describe how to get the activation energy of a reaction. (4 %)
- (c) Derive the integrated rate law of first-order reaction. (4 %)
5. (a) The $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ complex is violet but the $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$ complex is green.
Why do these two complexes have different colors? (4 %)
- (b). Which ligands has larger ability to produce d-orbital splitting? Why? (6 %)
6. (a) How to get the lattice size of a crystal. (4 %)
- (b) Draw the phase diagram of water, in which including the T_3 (triple point) and T_c (critical temperature) points. (4 %)