系所組別：奈米科技暨微系統工程研究所

考試科目：普通化學　　　　　　　　　　　　　　　　　　　　　　考試日期：0307，節次：2

※ 考生請注意：本試題 ☑可 □不可 使用計算機

一、選擇題: (66 %，每題 3 分)

1. Which of the following have a -C-O-H functional group?
   (A) ethers　(B) alcohols　(C) amines　(D) aldehydes

2. The number of half-lives needed for a radioactive element to decay to one-fourth of its
   original activity is (choose nearest number):
   (A) 3　(B) 4　(C) 2　(D) 5

3. The oxidation state of the sulfur atom in sulfuric acid is:
   (A) +2　　(B) +4　　(C) +6　　(D) -2

4. Choose the element with the smallest electronegativity.
   (A) N　(B) P　　(C) As　(D) Sb

5. Choose the metal with the smallest radius.
   (A) Li(s)　(B) Na(s)　(C) K(s)　(D) Mg(s)

6. Which of the following ions interferes with the action of detergents in hard water?
   (A) Na^+, Ca^{2+} and Mg^{2+}　(B) Ca^{2+} and Na^+　(C) Mg^{2+} and Na^+　(D) Ca^{2+} and Mg^{2+}

7. When 250.0 mL of 0.850 M HCl is diluted with 125.0 mL of water, the molarity of the
   solution is
   (A) 0.350 M　　(B) 0.425 M　(C) 0.567 M　　(D) 0.670 M

8. Which one of the following is the strongest intermolecular force experienced by Noble
   gases?
   (A) London dispersion forces　　(B) Dipole-dipole interactions
   (C) Hydrogen bonding　　　　　(D) Ion-ion

9. In which of the following processes will energy be released as heat?
   (A) sublimation (B) crystallization (C) vaporization (D) melting

10. What is the hybridization of S in the molecule H_2S?
    (A) sp　(B) sp^2　(C) sp^3　(D) dsp^3

(背面仍有題目,請繼續作答)

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11. As the bond order of a bond increases, its bond energy _____ and its bond length _____.

(A) increases, increases   (B) decreases, decreases

(C) increases, decreases   (D) decreases, increases

12. Which of the following is paramagnetic?

(A) B_2 (B) C_2 (C) H_2 (D) N_2

13. Which bond is the least polar?

(A) H-F   (B) H-N   (C) H-O   (D) H-C

14. How many moles of HCl(g) must be added to 1.0 L of 2.0 M NaOH to achieve a pH of 0.00 ? (Neglect any volume change.)

(A) 1.0 moles   (B) 2.0 moles   (C) 3.0 moles   (D) 10. moles

15. The conjugate base of a weak acid is

(A) a strong base   (B) a weak base   (C) a strong acid   (D) a weak acid

16. For a neutral solution, it must be true that

(A) pH = 7.00   (B) $[H^+]$ = 0 M   (C) $[H^+]$ = $[OH^-]$ (D) At least two of the above.

17. The equilibrium constant for A + 2B → 3C is 2.1×10^{-6} Determine the equilibrium constant for 2A + 4B → 6C.

(A) 4.2×10^{-6} (B) 4.4×10^{-12} (C) 2.1×10^{-6} (D) 4.8×10^{5}

18. Three identical 1.0-L flasks contain the gases He, Cl_2, and CH_4, each at 0°C and 1.0 atm pressure. Which gas has the highest density (g/L)?

(A) He   (B) Cl_2 (C) CH_4 (D) all gases the same

19. Three identical 1.0-L flasks contain the gases He, Cl_2, and CH_4, each at 0°C and 1.0 atm pressure. For which gas do the molecules have the smallest average kinetic energy?

(A) He   (B) Cl_2 (C) CH_4 (D) all gases the same

20. How many electrons can be described by the quantum numbers n = 4, l = 3, m_l = 0?

(A) 2   (B) 6   (C) 16   (D) 12

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21. In the reaction Cu(s) + AgNO$_3$(aq) → Cu(NO$_3$)$_2$(aq) + Ag(s), identify the oxidizing agent.
    (A) AgNO$_3$ (B) Cu   (C) Cu(NO$_3$)$_2$ (D) Ag

22. 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.

二、問答與計算題 (34 % ；計算題需寫過程否則不予計分)

1. Iron is used to reduce antimony in sulfide ores:
    SbS$_3$(s) + 3 Fe(s) → 2 Sb(s) + 3 FeS(s)   △H = − 300 kJ   (eq. 1)
    and carbon is used as the reducing agent in oxides ores:
    Sb$_4$O$_6$(s) + 6 C(s) → 4 Sb(s) + 6 CO(s)   △H = 600 kJ (eq. 2)
    Calculate the △S$_{surr}$ values for each reaction at 27 °C and 1 atm. (6 %)

2. (a). Write down the Nernst equation. (3 %)
   (b). A silver concentration cell is set up at 25°C with 1.0 M AgNO$_3$ in the right compartment (區間) and 2.0 M NaCl along with exceed AgCl(s) in the left compartment. The K$_{sp}$ of AgCl is 2.0 x 10^{-10} Calculate the cell voltage (ε). (6 %)

3. (a) Derive the integrated rate law of zero-order reaction. (5 %)
   (b) For a zero-order reaction with rate constant of 100 Ms^{-1}, please calculate the half-life (t$_{1/2}$) at initial concentration of 0.1 M. (3 %)
   (c) Illustrate an example of the zero-order reaction. (3 %)

4. (a) Please give the form of Schrödinger equation. (3 %)
   (b) What is photoelectric effect? (3 %)
   (c) Write down the de Broglie's equation. (3 %)