國立彰化師範大學 98 學年度碩士班招生考試試題

系所：科學教育研究所　　組別：丙組　　科目：普通化學

☆☆請在答案紙上作答☆☆　　

A.單選題(60%)

1. After carrying out the following operations, how many significant figures are appropriate to show in the result?

$(13.7 + 0.027) \div 8.221$

(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

2. Which of the following pairs of elements would be most likely to form an ionic compound?

(A) P and Br (B) Cu and K (C) C and O (D) O and Zn (E) Al and Rb

3. Based on the solubility rules, which of the following will occur when solutions of $ZnSO_4$(aq) and $MgCl_2$(aq) are mixed?

(A) $ZnCl_2$ will precipitate; Mg^{2+} and SO_4^{2-} will be spectator ions.

(B) $ZnSO_4$ will precipitate; Mg^{2+} and Cl^- will be spectator ions.

(C) $MgSO_4$ will precipitate; Zn^{2+} and Cl^- will be spectator ions.

(D) $MgCl_2$ will precipitate; Zn^{2+} and SO_4^{2-} will be spectator ions.

(E) No precipitate will form.

4. A possible set of quantum numbers for the last electron added to complete an atom of gallium Ga (atomic number = 31) in its ground state is

	n	l	m_l	m_s
(A)	4	0	0	–1/2
(B)	3	1	0	–1/2
(C)	4	1	0	+1/2
(D)	3	1	1	+1/2
(E)	4	2	1	+1/2

5. Which choice lists two elements with ground-state electron configurations that are well-known exceptions to the Aufbau principle?

(A) Cu and C (B) Cr and Cu (C) Cs and Cl (D) Rb and Co

(E) Fe and Co

6. What is the formal charge on the oxygen atom in N_2O (the atomic order is N–N–O)?

(A) 0 (B) +1 (C) –1 (D) –2 (E) +2

7. The F – Cl – F bond angles in ClF_3 are expected to be approximately

(A) 90° only. (B) 109.5° only. (C) 120° only.

(D) 180° only. (E) 90° and 180°.

8. What is the hybridization of the central atom in ClO_3^- ?

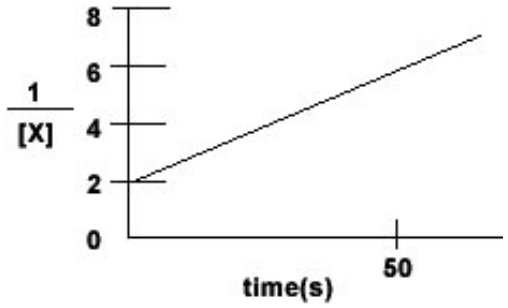
(A) sp (B) sp^2 (C) sp^3 (D) sp^3d (E) sp^3d^2

9. Consider the species N_2^-, N_2, and N_2^+. Which of these species will be paramagnetic?
(A) N_2 and N_2^- (B) N_2^+ and N_2 (C) N_2^+ and N_2^- (D) Only N_2^- (E) None are paramagnetic

10. Each of the following substances is a liquid at −50°C. Place these liquids in order of *increasing* vapor pressure: dimethyl ether (CH_3OCH_3), propane (C_3H_8), ethanol (CH_3CH_2OH)
(A) ethanol < propane < dimethyl ether
(B) ethanol < dimethyl ether < propane
(C) propane < dimethyl ether < ethanol
(D) dimethyl ether < ethanol < propane
(E) propane < ethanol < dimethyl ether

11. Silver metal crystallizes in a face-centered cubic lattice with L as the length of one edge of the unit cube. The center-to-center distance between nearest silver atoms is
(A) L/2 (B) $2^{½}$ L (C) 2L (D) L/$2^{½}$ (E) None of the above.

12. For the reaction X + Y → Z, the reaction rate is found to depend only upon the concentration of X. A plot of 1/X versus time gives a straight line.



What is the rate law for this reaction?
(A) rate = k [X] (B) rate = k $[X]^2$ (C) rate = k [X][Y] (D) rate = k $[X]^2$[Y]

13. For the following reactions the equilibrium constants are defined as follows:

$A + 2B \rightleftharpoons C \qquad K_1$

$C \rightleftharpoons D + E \qquad K_2$

For the reaction $A + 2B \rightleftharpoons D + E$, having equilibrium constant K_c,
(A) $K_c = K_1 + K_2$ (B) $K_c = K_1/K_2$ (C) $K_c = K_1 - K_2$
(D) $K_c = (K_1)(K_2)$ (E) $K_c = K_2/K_1$

14. Consider the weak bases below and their K_b values:

C_6H_7O $K_b = 1.3 \times 10^{-10}$

$C_2H_5NH_2$ $K_b = 5.6 \times 10^{-4}$

C_5H_5N $K_b = 1.7 \times 10^{-9}$

Arrange the conjugate acids of these weak bases in order of *increasing* acid strength.

(A) $C_5H_5NH^+ < C_6H_7OH < C_2H_5NH$

(B) $C_6H_7OH < C_5H_5NH^+ < C_2H_5NH$

(C) $C_5H_5NH^+ < C_2H_5NH_3^+ < C_6H_7OH$

(D) $C_6H_7OH < C_2H_5NH_3^+ < C_5H_5NH^+$

(E) $C_2H_5NH_3^+ < C_5H_5NH^+ < C_6H_7OH$

15. In which one of the following solutions will acetic acid have the greatest percent ionization?

(A) 0.1 M CH_3COOH

(B) 0.1 M CH_3COOH dissolved in 0.1 M HCl

(C) 0.1 M CH_3COOH dissolved in 0.2 M HCl

(D) 0.1 M CH_3COOH plus 0.1 M CH_3COONa

(E) 0.1 M CH_3COOH plus 0.2 M CH_3COONa

16. Which response includes *all* the following processes that are accompanied by an *increase* in entropy?

I. $2SO_2(g) + O_2(g) \rightarrow SO_3(g)$

II. $H_2O(l) \rightarrow H_2O(s)$

III. $Br_2(l) \rightarrow Br_2(g)$

IV. $H_2O_2(l) \rightarrow H_2O(l) + (1/2)O_2(g)$

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

17. Given the following notation for an electrochemical cell

$Pt(s) \mid H_2(g) \mid H^+(aq) \parallel Ag^+(aq) \mid Ag(s)$, what is the balanced overall (net) cell reaction?

(A) $2H^+(aq) + 2Ag^+(aq) \rightarrow H_2(g) + 2Ag(s)$

(B) $H_2(g) + 2Ag(s) \rightarrow H^+(aq) + 2Ag^+(aq)$

(C) $2H^+(aq) + 2Ag(s) \rightarrow H_2(g) + 2Ag^+(aq)$

(D) $H_2(g) + Ag^+(aq) \rightarrow H^+(aq) + Ag(s)$

(E) $H_2(g) + 2Ag^+(aq) \rightarrow 2H^+(aq) + 2Ag(s)$

18. According to the band theory, which of the following provide(s) an explanation for the high electrical conductivity of metals?

I. a partly filled conduction band
II. a valence band overlapping an empty conduction band
III. a filled valence band
IV. a large gap between the valence band and the conduction band

(A) I and II (B) I and III (C) III (D) III and IV (E) IV

19. In the complex ion $[ML_6]^{n+}$, M^{n+} has seven d electrons and L is a strong field ligand. According to crystal field theory, the magnetic properties of the complex ion correspond to how many unpaired electrons?

(A) 0 (B) 1 (C) 2 (D) 3 (E) 5

20. The backbone of a strand of nucleic acid consists of

(A) phosphate units only.
(B) phosphate and sugar units.
(C) polyester.
(D) phosphate, sugar, and nitrogen base units.
(E) sugar units only.

B.計算與簡答(40%)

1. Explain the following terms and give one example for each: (a) Law of multiple proportions (b) state function (c) Charles's Law (d) Le Chateller's Principle. **(8%)**

2. Find the standard enthalpy of formation of ethylene, $C_2H_4(g)$, given the following data: heat of combustion of $C_2H_4(g) = -1411$ kJ/mol; $\Delta H°_f[CO_2(g)] = -393.5$ kJ/mol; $\Delta H°_f[H_2O(l)] = -285.8$ kJ/mol. **(6%)**

3. A gas is allowed to expand, at constant temperature, from a volume of 1.0 L to 10.1 L against an external pressure of 0.50 atm. If the gas absorbs 250 J of heat from the surroundings, what are the values of q, w, and ΔE? (1 L·atm = 101.3 J) **(6%)**

4. Use the Born-Haber cycle to calculate the lattice energy of NaBr(s) given the following data: **(6%)**

ΔH(sublimation) Na = 177.8 kJ/mol
Ionization energy (Na) = 495.9 kJ/mol
Bond energy (Br–Br) = 192.5 kJ/mol
Electron affinity (Br) = –325 kJ/mol
ΔH_f (NaBr(s)) = –361.1 kJ/mol

5. Draw all isomers of (a) $[Ir(NH_3)_3Cl_3]$ (b) C_3H_5Cl. **(14%)**