臺灣綜合大學系統113學年度學士班轉學生聯合招生考試試題

科目名稱	普通化學B	類組代碼	共同考科
		科目碼	E0018

※本項考試依簡章規定所有考科均「不可」使用計算機。　　本科試題共計 3 頁

一、選擇題: (75 %; 單選；每題 3 分 ； 不倒扣)
請於答案卡上作答，否則不予計分。

1. Which is the correct formula for gold(I) sulfide?
(A) AuS ; (B) AuS_2 ; (C) Au_2S ; (D) Au_2S_3 ; (E) Au_2S_2

2. Compound X_2Y is 60% X by mass. What is the approximate percent of Y by mass in the compound X_2Y_2?
(A) 20% ; (B) 30% ; (C) 40% ; (D) 60% ; (E) 80%

3. Indium reacts with chlorine to form $InCl_3$. In the balanced equation for this reaction, the coefficient of the indium trichloride is
(A) 1 ; (B) 2 ; (C) 3 ; (D) 4 ; (E) 6

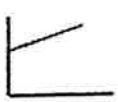
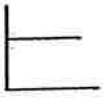
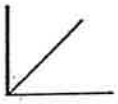
4. An aqueous solution of barium nitrate reacts with an aqueous solution of sodium sulfate. Identify the precipitate solid and indicate its coefficient in the balanced equation.
(A) $NaNO_3$, 1 ; (B) $BaSO_4$, 1 ; (C) $NaNO_3$, 2 ; (D) $BaSO_2$, 2 ; (E) $BaSO_3$, 1

5. True or False? The equation $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ is an oxidation-reduction reaction.
(A) True; the carbon is oxidized and oxygen is reduced.
(B) True; the carbon is reduced and the oxygen is oxidized.
(C) True; the carbon is oxidized and the hydrogen is reduced.
(D) True; the oxygen is reduced and the hydrogen is oxidized. ; (E) False

6. When the equation $Cl_2 \rightarrow Cl^- + ClO_3^-$ (basic solution) is balanced using the smallest whole-number coefficients, what is the coefficient of OH^-?
(A) 1 ; (B) 2 ; (C) 3 ; (D) 4 ; (E) 6

7. Consider a sample of neon gas in a container fitted with a movable piston (assume the piston is massless and frictionless). The temperature of the gas is increased from 20.0°C to 40.0°C. The density of neon
(A) increases less than 10% ; (B) decreases less than 10% ; (C) increases more than 10% ;
(D) decreases more than 10% ; (E) does not change.

8. Volume versus temperature in degrees Celsius for an ideal gas at constant pressure and number of Moles

(A)  (B)  (C) (D)  (E) none of these

9. If you were to heat acetic acid and 2-butanol with an acid catalyst, which of the following would you be most likely discover in your flask?
(A) a ketone ; (B) an ester ; (C) an ether ; (D) an alkane ; (E) an aldehyde

10. Which transition metal can exist in all oxidation states from +2 to +7?
(A) copper ; (B) vanadium ; (C) iron ; (D) chromium ; (E) manganese

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11. When the substances in the equation below are at equilibrium at pressure P and temperature T, how can the equilibrium be shifted to favor the products?

$$CuO(s) + H_2(g) \rightleftharpoons Cu(s) + H_2O(g) \qquad \Delta H = -2.0 \text{ kJ}.$$

(A) Decrease the temperature ; (B) Add a catalyst ;
(C) Increase the pressure by adding an inert gas such as nitrogen ;
(D) Increase the pressure by means of a moving piston at constant temperature ;
(E) Allow some gas to escape at constant pressure and temperature.

12. Calculate the following ratio of effusion rate at T_1 / effusion rate at T_2 for a gas at Kelvin temperatures T_1 and T_2 where $T_2 = 4T_1$.
(A) 0.5 ; (B) 2.0 ; (C) 4.0 ; (D) 0.25 ; (E) 1.0

13. Identify the strongest base.
(A) CN^- ; (B) CH_3OH ; (C) H_2O ; (D) NO_3^- ; (E) $CH_3CH_2O^-$

14. Find the pH of a solution at 25°C in which $[OH^-] = 2.5 \times 10^{-9}$ M.
(A) 8.60 ; (B) 5.40 ; (C) 7.40 ; (D) 6.50 ; (E) 2.50

15. What is the molar solubility of AgCl ($K_{sp} = 1.6 \times 10^{-10}$) in 0.0020 M sodium chloride?
(A) 0.0020 ; (B) 4.0×10^{-5} ; (C) 8.0×10^{-8} ; (D) 1.3×10^{-5} ; (E) 1.6×10^{-10}

16. An indicator HIn has $K_a = 1 \times 10^{-8}$. At pH = 6.0, what is the ratio HIn/In^-?
(A) 1/1 ; (B) 1/1000 ; (C) 1000/1 ; (D) 10/1 ; (E) 100/1

17. Suppose you add 45 J of heat to a system, let it do 10 J of expansion work, and then return the system to its initial state by cooling and compression. Which statement is true for this process?
(A) $\Delta H < \Delta E$; (B) $\Delta H = 70$ J ; (C) $\Delta E = 35$ J ; (D) ΔE for this process is zero ; (E) $\Delta H = 35$ J

18. Which of the following molecules has a dipole moment?
(A) SCl_6 ; (B) OF_2 ; (C) $SiCl_4$; (D) BH_3 ; (E) CF_4

19. A crystal of NaCl is
(A) soft, low-melting, and a good electrical conductor.
(B) hard, high-melting, and a poor electrical conductor.
(C) soft, low-melting, and a poor electrical conductor.
(D) soft, high-melting, and a good electrical conductor.
(E) hard, high-melting, and a good electrical conductor

20. The normal boiling point of liquid X is less than that of Y, which is less than that of Z. Which of the following is the correct order of increasing vapor pressure of the three liquids at STP?
(A) X, Y, Z ; (B) Y, X, Z ; (C) Z, Y, X ; (D) X, Z, Y ; (E) Y, Z, X

21. A salt solution sits in an open beaker. Assuming constant temperature and pressure, the vapor pressure of the solution
(A) decreases over time ; (B) increases over time ; (C) stays the same over time ;
(D) We need to know which salt is in the solution to answer this ;
(E) We cannot predict.

背面有題，請繼續作答。

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22. Choose the correct molecular structure for NO_3^-.
(A) trigonal bipyramidal ; (B) trigonal planar ; (C) tetrahedral ; (D) octahedral ; (E) square planar

23. For the process $Co(NH_3)_5Cl^{2+} + Cl^- \rightarrow Co(NH_3)_4Cl_2^+ + NH_3$, what would be the ratio of *cis* to *trans* isomers in the product?
(A) 1:1 ; (B) 2:1 ; (C) 4:1 ; (D) 1: 2 ; (E) 1:4

24. Specify the number of unpaired electrons in $[Ni(H_2O)_6]^{3+}$ (weak field). (Ni: $[Ar]4s^23d^8$)
(A) 1 ; (B) 2 ; (C) 3 ; (D) 4 ; (E) 5

25. 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.

二、問答與計算題 (25 %；計算與問答題需寫過程否則不予計分)

請於答案卷上作答，否則不予計分。

1. (a) Write down the Boltzmann's definition of entropy. (2 %)
(b) Simply describe the Second Law of Thermodynamics? (3 %)
(c) For the process involving compound A: A(s) → A(l), ΔH° = 8.0 kJ/mol, and ΔS° = 40.0 J/mol•K. What is the melting point of compound A? (3%)

2. (a) Derive the integrated rate law of second-order reaction. (4 %)
(b) Draw the energy plots for catalyzed and uncatalyzed pathway for a given reaction. (4 %)

3. (a) When a metal surface with an electron-binding energy of E_0 is radiated with a photon with a frequency ν ($h\nu > E_0$), please calculate the wavelength of the emitted electron. (The mass of electron is m_e) (4 %)
(b) Use the molecular orbital (MO) model and draw MO energy-level diagram to predict the magnetism and bond order of the O_2^+ ion. (5 %)