

國立成功大學

113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： 0202

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：(50%；每題 2 分)

- Which is the correct formula for gold(I) sulfide?
(A) AuS ; (B) Au₂S ; (C) Au₂S₃ ; (D) AuS₂ ; (E) Au₃S₂
- When the equation $\text{H}_2\text{SnCl}_6 + \text{H}_2\text{S} \rightarrow \text{SnS}_2 + \text{HCl}$ is balanced with the smallest set of integers, the sum of the coefficients is
(A) 7 ; (B) 8 ; (C) 9 ; (D) 10 ; (E) 14
- When $\text{NH}_3(\text{aq})$ is added to $\text{Cu}^{2+}(\text{aq})$, a precipitate initially forms. What is its formula?
(A) $\text{Cu}(\text{NH}_3)$; (B) $\text{Cu}(\text{NO}_3)_2$; (C) $\text{Cu}(\text{OH})_2$; (D) $\text{Cu}(\text{NH}_3)_2$; (E) CuO
- Which of the following reactions does *not* involve oxidation-reduction?
(A) $\text{CH}_4 + 2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{CO}_2$; (B) $\text{Mg} + 2\text{HI} \rightarrow \text{MgI}_2 + \text{H}_2$; (C) $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$;
(D) $\text{MnO}_2 + 4\text{HI} \rightarrow \text{I}_2 + 2\text{H}_2\text{O} + \text{MnI}_2$; (E) $\text{LiOH} + \text{HCl} \rightarrow \text{H}_2\text{O} + \text{LiCl}$
- Consider three 1-L flasks of ideal gases at the same temperature and pressure. Flask A contains NO gas, flask B contains N₂ gas, and flask C contains O₂ gas.
In which flask do the molecules have the greatest momentum per impact on the wall?
(A) flask A ; (B) flask B ; (C) flask C ; (D) Molecules in all flasks have the same momentum per impact. ;
(E) The molecules in two of the flasks have the same momentum per impact.
- To increase the value of K for the endothermic reaction. $2 \text{NH}_3(\text{g}) \rightleftharpoons 3 \text{H}_2(\text{g}) + \text{N}_2(\text{g})$
we should:
(A) increase the total pressure. ; (B) decrease the total pressure. ; (C) increase the temperature. ;
(D) decrease the temperature. ; (E) decrease the temperature and increase the total pressure.
- Find the pH of a solution at 25°C in which $[\text{OH}^-] = 2.5 \times 10^{-9} \text{ M}$.
(A) 5.40 ; (B) 6.50 ; (C) 7.40 ; (D) 8.60 ; (E) 8.40
- What is the pH in a solution of 1.0 M H₂A ($K_{a1} = 1.0 \times 10^{-6}$; $K_{a2} = 1.0 \times 10^{-14}$)?
(A) 10.0 ; (B) 4.0 ; (C) 7.0 ; (D) 13.00 ; (E) 3.00
- If 20 mL of 0.50 M HCl is added to 100 mL of 0.20 M NaOH, what is the final pH?
(A) 12.92 ; (B) 1.08 ; (C) 13.22 ; (D) 0.78 ; (E) 7.00

10. For a particular process $q = -10$ kJ and $w = 25$ kJ. Which of the following statements is true?
(A) Heat flows from the surroundings to the system ; (B) The system does work on the surroundings ;
(C) $\Delta E = -35$ kJ ; (D) $\Delta E = 35$ kJ ; (E) None of these is true.
11. For the reaction $A + B \rightarrow C + D$, $\Delta H^\circ = +40$ kJ and $\Delta S^\circ = +50$ J/K. Therefore, the reaction under standard conditions is:
(A) spontaneous at temperatures less than 8 K ; (B) spontaneous at temperatures greater than 800 K ;
(C) spontaneous only at temperatures between 8 K and 800 K ; (D) spontaneous at all temperatures ;
(E) nonspontaneous at all temperatures.
12. The standard free energy of formation of $\text{AgCl}(s)$ is -110 . kJ/mol. Calculate ΔG° for the reaction
 $2\text{AgCl}(s) \rightarrow 2\text{Ag}(s) + \text{Cl}_2(g)$
(A) 110. kJ ; (B) 220. kJ ; (C) -110 . kJ ; (D) -220 . kJ ; (E) none of these
13. How many electrons in an atom can have the quantum numbers $n = 3, l = 2$?
(A) 2 ; (B) 6 ; (C) 10 ; (D) 18 ; (E) 4
14. The valence electron configuration of an element is $ns^2(n-1)d^{10}np^2$. To which group does X belong?
(A) Group 3A ; (B) Group 4A ; (C) Group 5A ; (D) Group 6A ; (E) Group 7A
15. In which case is the bond polarity *incorrect*?
(A) δ^+ H-Br δ^- ; (B) δ^+ Na-S δ^- ; (C) δ^+ Mg-H δ^- ; (D) δ^+ Cl-Br δ^- ; (E) δ^+ Si-S δ^-
16. How many of the following molecules and ions contain double or triple bonds?
 N_2 H_2CO C_2H_4 C_2H_6 SCN^-
(A) 1 ; (B) 2 ; (C) 3 ; (D) 4 ; (E) 5
17. Which of the following species has the largest dissociation energy?
(A) O_2^{2+} ; (B) O_2^+ ; (C) O_2 ; (D) O_2^- ; (E) O_2^{2-}
18. Which of the following statements is *incorrect*?
(A) Molecular solids have high melting points ;
(B) Binding forces in a molecular solid include London dispersion forces ;
(C) Ionic solids have high melting points ; (D) Ionic solids are insulators ;
(E) All of these statements are correct.

19. Rank the following compounds according to increasing solubility in water.

I. $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$; II. $\text{CH}_3\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$; III. $\text{CH}_3\text{-CH}_2\text{-OH}$; IV. $\text{CH}_3\text{-OH}$

- (A) $\text{I} < \text{III} < \text{IV} < \text{II}$; (B) $\text{I} < \text{II} < \text{III} < \text{IV}$; (C) $\text{I} < \text{II} < \text{IV} < \text{III}$;
(D) $\text{III} < \text{IV} < \text{II} < \text{I}$; (E) $\text{II} < \text{I} < \text{III} < \text{IV}$

20. A cucumber is placed in a concentrated salt solution. What is most likely to happen?

- (A) Water will flow from the solution to the cucumber; (B) Water will flow from the cucumber to the solution ; (C) Salt will flow into the cucumber ; (D) Salt will precipitate out ; (E) No change will occur.

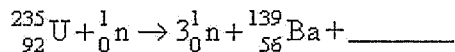
21. Choose the element with the smallest electronegativity.

- (A) O ; (B) N ; (C) S ; (D) Si ; (E) Br

22. The deciding factor that makes HF a weak acid is that

- (A) the enthalpy of hydration of F^- is negative; (B) HF has a large bond energy;
(C) the entropy for hydration of F^- is a large negative value; (D) F_2 has a small bond energy;
(E) F^- has the largest ionization energy of all the halide ions

23. What nuclide is necessary to balance the following fission reaction?



- (A) ${}_{35}^{96}\text{Br}$; (B) ${}_{36}^{96}\text{Kr}$; (C) ${}_{37}^{94}\text{Rb}$; (D) ${}_{36}^{94}\text{Kr}$; (E) ${}_{38}^{90}\text{Sr}$

24. The half-life for electron capture for ${}_{19}^{40}\text{K}$ is 1.30×10^9 years. What percent of the original ${}_{19}^{40}\text{K}$ remains after 3.90×10^9 years?

- (A) 75 % ; (B) 50% ; (C) 33.3% ; (D) 25 % ; (E) 12.5%

25. Which of the following yields a primary alcohol upon reduction?

- (A) a ketone ; (B) an alkene ; (C) an amine ; (D) an ether; (E) an aldehyde

二、問答與計算題 (50 %; 計算與問答題需寫過程否則不予計分)

- (a). Derive the equations: $\Delta H = q_p$ (5%);

(b). Describe a simple method to measure the free energy change for a very slow reaction of
$$\text{C}(\text{graphite}) \rightarrow \text{C}(\text{diamond})$$
 (5%)
- (a). Draw a concentration vs. time plot for a zero-order reaction. (4 %)

(b). For a second-order reaction with rate constant of $100 \text{ M}^{-1}\text{s}^{-1}$, please calculate the half-life ($t_{1/2}$) at initial concentration of 0.1 M . (6 %)
- (a). The $\text{Fe}(\text{H}_2\text{O})_6^{3+}$ ion is colorless. Why is the aqueous solution of Fe(III) salts usually yellow to brown in color and highly acidic ($\text{pH} < 4.0$)? (4 %)

(b). The CO is a strong-field ligand. Please draw the electron arrangement in the split 3d orbital of the $\text{Fe}(\text{CO})_6^{3+}$.
(Fe: $[\text{Ar}]4s^23d^6$) (6 %)
- (a) Why is the vibration frequency of C–H at $2850\text{--}3300 \text{ cm}^{-1}$ higher than that of C–O bond at $1080\text{--}1300 \text{ cm}^{-1}$? (4 %).

(b) Draw and brief describe a $^1\text{H-NMR}$ spectrum of the $\text{CH}_3\text{CH}_2\text{-Br}$.
(including the internal standard TMS, chemical shift and spin-spin coupling) (6 %)
- (a). Write down the Nernst equation. (Hint: ϵ , ϵ° , Q) (3 %)

(b). A silver concentration cell is set up at 25°C with 1.0 M AgNO_3 in the right compartment and 2.0 M NaCl along with exceed $\text{AgCl}(s)$ in the left compartment. The K_{sp} of $\text{AgCl} = 2.0 \times 10^{-10}$. Calculate the cell voltage (ϵ).
($\text{Ag}^+ + e^- \rightarrow \text{Ag}$; $\epsilon^\circ = 0.80 \text{ V}$) (7 %)