

注意：考試開始鈴響前，不可以翻閱試題

台灣聯合大學系統 107 學年度學士班轉學考試題

考試科目：普通化學

組別：A1

參考用

—作答注意事項—

1. 作答中如發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
2. 請核對答案卷（卡）上之准考證號、考試科目是否正確。
3. 本考科可使用電子計算器（一般認知之小型電子計算器），不限廠牌型號，但不包含手機、平板或其他智慧型手持裝置。
4. 選擇題請在答案卡上作答，非選擇題請在答案卷（作答區內）作答。
5. 考生限在作答區內作答，不可書寫姓名、准考證號或與作答無關之其他文字或符號。
6. 答案卷用盡不得要求增加。
7. 答案卷限用藍筆或黑色鋼筆、原子筆或鉛筆書寫；答案卡限用 2B 軟心鉛筆畫記，如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果考生自行負責。
8. 因字跡潦草或作答未標明題號等情事，致評閱人員無法辨識答案者，該部分不予計分。

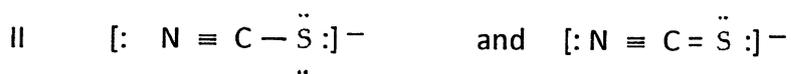
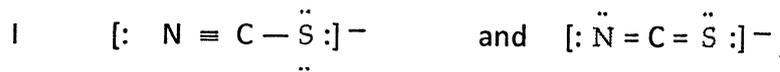
## 一、 單選題 80% (20 題 每題 4 分)

1. Which group of elements reacts violently with water?  
A) halogens  
B) noble gases  
C) alkali metals  
D) alkaline earth metals
2. 1 mole of  $O_2$  contains the same number of oxygen atoms as  
A) 0.667 mole of  $O_3$ .  
B) 1.00 mole of  $CH_3CO_2H$ .  
C) 2.00 mole of  $CH_3CH_2OH$ .  
D) All of the above
3. What is the concentration of  $NO_3^-$  ions in a solution prepared by dissolving 15.0 g of  $Ba(NO_3)_2$  in enough water to produce 300. mL of solution?  
A) 0.057 M  
B) 0.191 M  
C) 0.573 M  
D) 0.382 M
4. Light can be made to have a higher intensity by raising its  
A) amplitude.  
B) energy.  
C) frequency.  
D) wavelength.
5. Consider the following ground state electron configuration:  $1s^2 2s^2 2p^4$ . Which of the ions has this ground state electron configuration?  
A) F<sup>-1</sup>  
B) N<sup>+1</sup>  
C) C<sup>-2</sup>  
D) O<sup>-2</sup>

參考用

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6. Which of the following are allowed resonance forms of  $\text{NCS}^-$ ?



- A) only I  
B) only II  
C) only III  
D) I and III

7. What is the F—B—F bond angle in  $\text{BF}_3$ ?

- A) less than  $109.5^\circ$   
B)  $109.5^\circ$   
C)  $120^\circ$   
D) greater than  $120^\circ$

8. For a process at constant pressure,

- A)  $\Delta E = w$  and  $q = 0$ .  
B)  $\Delta E = q$  and  $w = 0$ .  
C)  $\Delta E = \Delta H$ .  
D)  $\Delta H = q$ .

9. A 1.75 L container filled with  $\text{CO}_2$  gas at  $25^\circ\text{C}$  and 225 kPa pressure springs a leak. When the container is re-sealed, the pressure is 200 kPa and the temperature is  $10^\circ\text{C}$ . How many moles of gas were lost?

- A) 0.0101 mol  
B) 0.149 mol  
C) 6.71 mol  
D) 99.0 mol

10. Bromine is one of only two elements that is a liquid at room temperature.

Bromine has a heat of vaporization of 30.91 kJ/mol and its boiling point is  $59^\circ\text{C}$ .

What is the entropy of vaporization for bromine?

- A)  $-301 \text{ J}/(\text{mol} \cdot \text{K})$   
B)  $-93.1 \text{ J}/(\text{mol} \cdot \text{K})$   
C)  $10.7 \text{ J}/(\text{mol} \cdot \text{K})$

參考用

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參考用

D) 93.1 J/(mol · K)

11. To make a 3.0 M solution, one could take 3.00 moles of solute and add

- A) 1.00 L of solvent.  
 B) 1.00 kg of solvent.  
 C) enough solvent to make 1.00 L of solution.  
 D) enough solvent to make 1.00 kg of solution.

12. For a reaction that follows the general rate law,  $\text{Rate} = k[\text{A}][\text{B}]^2$ , what will happen to the rate of reaction if the concentration of B is increased by a factor of 2.00? The rate will

- A) decrease by a factor of 1/4.00.  
 B) decrease by a factor of 1/2.00.  
 C) increase by a factor of 2.00.  
 D) increase by a factor of 4.00.

13. A mixture of carbon monoxide, hydrogen, and methanol is at equilibrium. The balanced chemical equation is:  $\text{CO}(g) + 2 \text{H}_2(g) \rightleftharpoons \text{CH}_3\text{OH}(g)$ . At 250°C, the mixture contains 0.0960 M CO, 0.191 M H<sub>2</sub>, and 0.150 M CH<sub>3</sub>OH. What is the value for K<sub>c</sub>?

- A)  $2.33 \times 10^{-2}$   
 B) 0.244  
 C) 4.09  
 D) 42.8

14. Write a balanced equation for the dissociation of the Brønsted-Lowry acid HSO<sub>4</sub><sup>-</sup> in water.

- A)  $\text{HSO}_4^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_2\text{SO}_4(aq) + \text{OH}^-(aq)$   
 B)  $\text{HSO}_4^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{SO}_4^{2-}(aq) + \text{H}_3\text{O}^+(aq)$   
 C)  $\text{HSO}_4^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{SO}_3^{2-}(aq) + \text{OH}^-(aq)$   
 D)  $\text{HSO}_4^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{SO}_3(g) + \text{OH}^-(aq) + \text{H}_2\text{O}(l)$

15. What is **not** a correct expression for the weak acid HA?

- A)  $K_a = [\text{H}_3\text{O}^+][\text{A}^-]/[\text{HA}]$   
 B)  $\text{p}K_a = \text{pH} - \log\{[\text{A}^-]/[\text{HA}]\}$   
 C)  $\text{p}K_a = \log K_a$

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D)  $pK_a = 14 - pK_b$

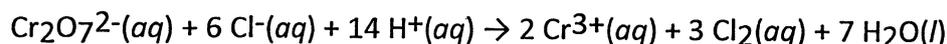
16. Which forward reaction is a nonspontaneous process?

A) The expansion of a gas into a vacuum

B)  $N_2(g) + 3 H_2(g) \rightleftharpoons 2 NH_3(g)$  if  $P_{H_2} = P_{N_2} = 1 \text{ atm}$ ,  $P_{NH_3} = 0$ , and  $K_p = 4 \times 10^5$ C)  $2 NH_3(g) \rightleftharpoons N_2(g) + 3 H_2(g)$  if  $P_{NH_3} = 1 \text{ atm}$ ,  $P_{H_2} = P_{N_2} = 0$ , and  $K_p = 2 \times 10^{-6}$ 

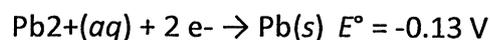
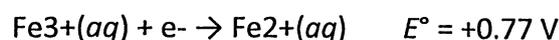
D) None of these

17. What is the oxidation half reaction in the following chemical reaction?

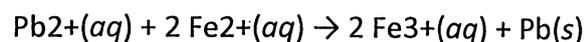
A)  $Cr_2O_7^{2-}(aq) + 14 H^+(aq) + 6 e^- \rightarrow 2 Cr^{3+}(aq) + 7 H_2O(l)$ B)  $Cr_2O_7^{2-}(aq) + 14 H^+(aq) \rightarrow 2 Cr^{3+}(aq) + 7 H_2O(l) + 6 e^-$ C)  $2 Cl^-(aq) \rightarrow Cl_2(aq) + 2 e^-$ D)  $Cl_2(aq) + 2 e^- \rightarrow 2 Cl^-(aq)$ 

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18. Using the following standard reduction potentials



calculate the standard cell potential for the galvanic cell reaction given below, and determine whether or not this reaction is spontaneous under standard conditions.

A)  $E^\circ = -0.90 \text{ V}$ , nonspontaneousB)  $E^\circ = -0.90 \text{ V}$ , spontaneousC)  $E^\circ = +0.90 \text{ V}$ , nonspontaneousD)  $E^\circ = +0.90 \text{ V}$ , spontaneous

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科目 普通化學 類組別 A1共 6 頁 第 5 頁

19. Iodine-123, used in thyroid therapy, has a half-life of 13.27 hours. How many half-lives are required for a 160 mg sample of iodine-123 to decay to 5.0 mg?

- A) 0.031
- B) 1.0
- C) 5.0
- D) 32

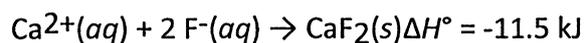
20. A common rule in organic chemistry is that increasing the temperature of a reaction at room temperature by 10°C doubles the rate. Calculate  $E_a$  for a reaction that follows this rule. Assume room temperature is 25°C.

- A) 0.576 kJ
- B) 12.2 kJ
- C) 38.4 kJ
- D) 52.9 kJ

參考用

計算 (20%, 每題五分)

- [1]. The Balmer-Rydberg equation can be extended to ions with only one electron, such as  $\text{He}^+$ . In that case it has the form:  $1/\lambda = Z^2R(1/m^2 - 1/n^2)$ , where  $Z$  is the atomic number. Derive the energy (expressed in terms of  $h$   $c$  and  $R$ ) of the photon required to promote an electron in  $\text{He}^+$  from a  $1s$  orbital to a  $2p$  orbital?
- [2]. When 50.0 mL of 0.400 M  $\text{Ca}(\text{NO}_3)_2$  is added to 50.0 mL of 0.800 M  $\text{NaF}$ ,  $\text{CaF}_2$  precipitates, as shown in the net ionic equation below. The initial temperature of both solutions is 30.00°C. Assuming that the reaction goes to completion, and that the resulting solution has a mass of 100.00 g and a specific heat of 4.18 J/(g · °C), calculate the final temperature of the solution.



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- [3]. A concentration-time study of the gas phase reaction  $2 A_3 \rightarrow 3 A_2$  produced the data in the table below.

Time (s)	[A <sub>3</sub> ] (M)	[A <sub>2</sub> ] (M)
0	$4.00 \times 10^{-4}$	0
10	$2.00 \times 10^{-4}$	$3.00 \times 10^{-4}$
20	$1.00 \times 10^{-4}$	$4.50 \times 10^{-4}$
30	$5.00 \times 10^{-5}$	?

What is the average rate of decomposition of A<sub>3</sub> in the time interval 20-30 seconds?

- [4]. The second-order reaction,  $2 Mn(CO)_5 \rightarrow Mn_2(CO)_{10}$  has a rate constant equal to  $3.0 \times 10^9 M^{-1}s^{-1}$  at 25°C. If the initial concentration of Mn(CO)<sub>5</sub> is  $1.0 \times 10^{-5}$  M, how long will it take for 90.% of the reactant to disappear?

參考用

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