

臺灣綜合大學系統 112 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 4 頁

一、選擇題：(每題 4 分) 請於答案卡上作答，否則不予計分。

- What is the sodium ion concentration when 70.0 mL of 3.0 M sodium carbonate is added to 30 mL of 1.0 M sodium bicarbonate?  
(A) 4.5 M (B) 2.5 M (C) 0.25 M (D) 4 M
- Assign oxidization states to Fe of  $K_4Fe(CN)_6$   
(A) +2 (B) +3 (C) +4 (D) +6
- Consider three identical flasks filled with different gases:  
Flask A: CO at 760 torr and 0 °C  
Flask B:  $N_2$  at 250 torr and 0 °C  
Flask C:  $H_2$  at 100 torr and 0 °C  
In which flask will the molecules have the greatest average kinetic energy?  
(A) Flask A (B) Flask B (C) Flask C (D) All the same
- A tank contains a mixture of 52.5 g oxygen gas and 65.1 g carbon dioxide gas at 27 °C. The total pressure in the tank is 9.21 atm.  
Calculate the partial pressure of each gas in the container.  
(A)  $P_{O_2} = 4.37$  atm,  $P_{CO_2} = 4.84$  atm (B)  $P_{O_2} = 5.84$  atm,  $P_{CO_2} = 3.37$  atm  
(C)  $P_{O_2} = 4.84$  atm,  $P_{CO_2} = 4.37$  atm (D)  $P_{O_2} = 6.00$  atm,  $P_{CO_2} = 3.21$  atm
- At 900 °C,  $K_p = 1.04$  for the reaction  
 $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$   
At a low temperature 58.4 g dry ice (solid  $CO_2$ ), 95.0 g calcium oxide, and 655 g calcium carbonate are introduced into a 50.0-L reaction chamber. The temperature is raised to 900 °C.  
What will the initial amount of calcium oxide as the system moves toward equilibrium?  
(A) increase (B) decrease (C) remain the same.
- Calculate a value for the equilibrium constant for the reaction  
 $O_2(g) + O(g) \rightleftharpoons O_3(g)$   
given that  
 $NO_2(g) \rightleftharpoons NO(g) + O(g) \quad K = 6.8 \times 10^{-49}$   
 $O_3(g) + NO(g) \rightleftharpoons NO_2(g) + O_2(g) \quad K = 5.8 \times 10^{-34}$   
(A)  $8.5 \times 10^{-14}$  (B)  $1.17 \times 10^{-15}$  (C)  $5.2 \times 10^{-15}$  (D)  $2.6 \times 10^{81}$
- Calculate the pH of a 0.2 M  $C_2H_5NH_2$  solution ( $K_b = 5.6 \times 10^{-13}$ )  
(A) 10 (B) 6 (C) 12 (D) 9
- In aqueous solution,  $HNO_2$  as  
(A) strong acid (B) weak acid (C) strong base (D) weak acid
- Calculate the pH of a solution that is 0.60 M HF and 1.00 M  $F^-$ . ( $K_a = 7.2 \times 10^{-4}$ )  
(A) 4.37 (B) 6.36 (C) 3.37 (D) 2.58
- Calculate the solubility of solid  $Ca_3(PO_4)_2$  ( $K_{sp} = 1.3 \times 10^{-32}$ ) in a 0.2 M  $Na_3PO_4$  solution.  
(A)  $2.3 \times 10^{-11}$  (B)  $6.5 \times 10^{-11}$  (C)  $8.2 \times 10^{-12}$  (D)  $2.3 \times 10^{-12}$  mol/L

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<p>11. A sample of an ideal gas at 15.0 atm and 10.0 L is allowed to expand against a constant external pressure of 2.00 atm at a constant temperature. Calculate the work in units of kJ for the gas expansion. (1 L*atm=101.325 J)                      (A) 13200 kJ (B) -13200 kJ (C) 13.2 kJ (D) -13.2 kJ</p> <p>12. Using the following data, calculate the standard heat of formation of ICl(g) in kJ/mol:  <math>\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g}) \quad \Delta H^\circ = 242.3 \text{ kJ}</math>  <math>\text{I}_2(\text{g}) \rightarrow 2\text{I}(\text{g}) \quad \Delta H^\circ = 151.0 \text{ kJ}</math>  <math>\text{ICl}(\text{g}) \rightarrow \text{I}(\text{g}) + \text{Cl}(\text{g}) \quad \Delta H^\circ = 211.3 \text{ kJ}</math>  <math>\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{g}) \quad \Delta H^\circ = 62.8 \text{ kJ}</math>                      (A) 25.8 kJ/mol (B) 16.8 kJ/mol (C) 51.6 kJ/mol (D) -16.8 kJ/mol</p> <p>13. Which of the following processes require energy as they occur?                      (A) Salt dissolves in H<sub>2</sub>O.                      (B) A clear solution becomes a uniform color after a few drops of dye are added.                      (C) A satellite is launched into orbit.                      (D) Iron rusts.</p> <p>14. Consider the process  <math>\text{A}(\text{l}) \rightarrow \text{A}(\text{g})</math>                      75 °C      155 °C                      which is carried out at constant pressure. The total <math>\Delta S</math> for this process is known to be 75.0 J K<sup>-1</sup> mol<sup>-1</sup>. For A(l) and A(g), the C<sub>p</sub> values are 75.0 J K<sup>-1</sup> mol<sup>-1</sup> and 29.0 J K<sup>-1</sup> mol<sup>-1</sup>, respectively. Calculate <math>\Delta H_{\text{vaporization}}</math> for A(l) at 125 °C (its boiling point)                      (A) 1.5 x 10<sup>4</sup> J (B) 2.5 x 10<sup>4</sup> J (C) 1.5 x 10<sup>3</sup> J (D) 6.5 x 10<sup>3</sup> J</p> <p>15. Which of the following orbital designations are incorrect.                      (A) 1s (B) 3f (C) 9s (D) 4f</p> <p>16. Calculate the shortest wavelength of light emitted by electrons in the hydrogen atom that begin in the n = 6 state and then fall to states with smaller value of n.                      (E = -2.178 x 10<sup>-18</sup> J (Z<sup>2</sup>/n<sup>2</sup>); <math>\Delta E = h(c/\lambda)</math>; <math>h = 6.626 \times 10^{-34}</math> J s; <math>c = 3 \times 10^8</math> m/s)                      (A) 7462 nm (B) 121.6 nm (C) 93.8 nm (D) 588.3 nm</p> <p>17. What is the bond order of He<sub>2</sub>?                      (A) 0 (B) 1 (C) 1.5 (D) 2</p> <p>18. Theophylline is a pharmaceutical drug that is sometimes used to help with lung function. You observe a case where the initial lab results indicate that the concentration of theophylline in a patient's body decreased from 2.0 x 10<sup>3</sup> M to 1.0 x 10<sup>3</sup> M in 24 hours. In another 12 hours, the drug concentration was found to be 5.0 x 10<sup>4</sup> M. What is the value of the rate constant for the metabolism of this drug in the body?                      (A) 4.2 x 10<sup>3</sup> mol L<sup>-1</sup> h<sup>-1</sup> (B) 8.4 x 10<sup>3</sup> mol L<sup>-1</sup> h<sup>-1</sup> (C) 8.4 x 10<sup>4</sup> mol L<sup>-1</sup> h<sup>-1</sup> (D) 4.2 x 10<sup>5</sup> mol L<sup>-1</sup> h<sup>-1</sup></p>			

背面有題，請繼續作答。

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19. How much energy does it take to convert 0.500 kg of ice at  $-20\text{ }^{\circ}\text{C}$  to steam at  $250\text{ }^{\circ}\text{C}$ ?

Specific heat capacities: ice,  $2.1\text{ J g}^{-1}\text{ }^{\circ}\text{C}^{-1}$ ; liquid,  $4.2\text{ J g}^{-1}\text{ }^{\circ}\text{C}^{-1}$ ; steam,  $2.0\text{ J g}^{-1}\text{ }^{\circ}\text{C}^{-1}$ ;

$\Delta H_{\text{vap}} = 40.7\text{ kJ/mol}$ ;  $\Delta H_{\text{fus}} = 6.01\text{ kJ/mol}$ .

(A) 135 kJ (B) 320 kJ (C) 1680 kJ (D) 2560 kJ

20. What is the hybridization of the central atom of  $\text{SF}_6$ ?

(A)  $\text{sp}^3$  (B)  $\text{dsp}^3$  (C)  $\text{sp}$  (D)  $\text{d}^2\text{sp}^3$

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二、計算題：(每題 10 分) 請於答案卷上作答，否則不予計分。

1. The reaction  $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$  was studied at several temperatures and the following values of  $k$  (rate constant) were obtained:

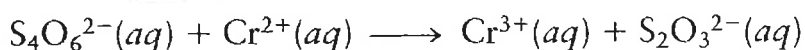
$k$ ( $\text{s}^{-1}$ )	$T$ ( $^{\circ}\text{C}$ )
$2.0 \times 10^{-5}$	20
$7.3 \times 10^{-5}$	30
$2.7 \times 10^{-4}$	40
$9.1 \times 10^{-4}$	50
$2.9 \times 10^{-3}$	60

Calculate the value of  $E_a$  for this reaction.

( $k = A e^{-E_a/RT}$ ; A: pre-exponential factor; R:  $8.1345 \text{ J K}^{-1} \text{ mol}^{-1}$ )

Ans:

2. For the oxidation-reduction reaction



the appropriate half-reactions are



Balance the redox reaction and calculate  $\mathcal{E}^{\circ}$  and  $K$  (at  $25^{\circ} \text{C}$ ).

Ans: