

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: N₂ at 250 torr and 0 °C
Flask C: H₂ 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_{O₂} = 4.37 atm, P_{CO₂} = 4.84 atm (B) P_{O₂} = 5.84 atm, P_{CO₂} = 3.37 atm
(C) P_{O₂} = 4.84 atm, P_{CO₂} = 4.37 atm (D) P_{O₂} = 6.00 atm, P_{CO₂} = 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 CO₂), 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) 8.5×10^{-14} (B) 1.17×10^{-15} (C) 5.2×10^{-15} (D) 2.6×10^{61}
- Calculate the pH of a 0.2 M C₂H₅NH₂ solution (K_b = 5.6×10^{-13})
(A) 10 (B) 6 (C) 12 (D) 9
- In aqueous solution, HNO₂ 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 = 7.2×10^{-4})
(A) 4.37 (B) 6.36 (C) 3.37 (D) 2.58
- Calculate the solubility of solid Ca₃(PO₄)₂ (K_{sp} = 1.3×10^{-32}) in a 0.2 M Na₃PO₄ solution.
(A) 2.3×10^{-11} (B) 6.5×10^{-11} (C) 8.2×10^{-12} (D) 2.3×10^{-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: $\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g}) \quad \Delta H^\circ = 242.3 \text{ kJ}$ $\text{I}_2(\text{g}) \rightarrow 2\text{I}(\text{g}) \quad \Delta H^\circ = 151.0 \text{ kJ}$ $\text{ICl}(\text{g}) \rightarrow \text{I}(\text{g}) + \text{Cl}(\text{g}) \quad \Delta H^\circ = 211.3 \text{ kJ}$ $\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{g}) \quad \Delta H^\circ = 62.8 \text{ kJ}$ (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 H₂O. (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 $\text{A}(\text{l}) \rightarrow \text{A}(\text{g})$ 75 °C 155 °C which is carried out at constant pressure. The total ΔS for this process is known to be 75.0 J K⁻¹ mol⁻¹. For A(l) and A(g), the C_p values are 75.0 J K⁻¹ mol⁻¹ and 29.0 J K⁻¹ mol⁻¹, respectively. Calculate $\Delta H_{\text{vaporization}}$ for A(l) at 125 °C (its boiling point) (A) 1.5 x 10⁴ J (B) 2.5 x 10⁴ J (C) 1.5 x 10³ J (D) 6.5 x 10³ 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 10⁻¹⁸ J (Z²/n²); $\Delta E = h(c/\lambda)$; h = 6.626 x 10⁻³⁴ J s; c = 3 x 10⁸ 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 He₂? (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 10³ M to 1.0 x 10³ M in 24 hours. In another 12 hours, the drug concentration was found to be 5.0 x 10⁴ M. What is the value of the rate constant for the metabolism of this drug in the body? (A) 4.2 x 10³ mol L⁻¹ h⁻¹ (B) 8.4 x 10³ mol L⁻¹ h⁻¹ (C) 8.4 x 10⁴ mol L⁻¹ h⁻¹ (D) 4.2 x 10⁵ mol L⁻¹ h⁻¹</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 SF_6 ?

(A) sp^3 (B) dsp^3 (C) sp (D) d^2sp^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:

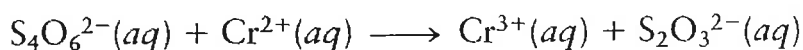
k (s^{-1})	T ($^{\circ}\text{C}$)
2.0×10^{-5}	20
7.3×10^{-5}	30
2.7×10^{-4}	40
9.1×10^{-4}	50
2.9×10^{-3}	60

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}° and K (at 25°C).

Ans: