

國立成功大學
110學年度碩士班招生考試試題

編 號： 143

系 所： 環境工程學系

科 目： 普通化學

日 期： 0202

節 次： 第 1 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。

Part I Calculations.

1. A compound containing carbon, nitrogen, and hydrogen is combusted completely with excess oxygen to produce 138 g of NO_2 , 28.0 g of CO_2 , and 90.0 g of H_2O . What is the empirical formula of the compound? (10 points)
2. Arrange the following aqueous solutions, each 10% by mass in solute, in order of decreasing boiling point: glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), sucrose ($\text{C}_{11}\text{H}_{22}\text{O}_{11}$), sodium nitrate (NaNO_3). (10 points)
3. Complete combustion of 1.00 mol of acetone $\text{C}_3\text{H}_6\text{O}$ liberates 1790 kJ of heat. Given that $\Delta H_f^\circ(\text{CO}_2) = -393.5 \text{ kJ/mol}$ and $\Delta H_f^\circ(\text{H}_2\text{O}) = -285.8 \text{ kJ/mol}$, calculate the standard enthalpy of formation of acetone. (10 points)
4. Ethylenediamine has an empirical formula NH_2CH_2 . Assume that 95 mg of ethylenediamine in the gas phase has a pressure of 235 mmHg in a 125 mL flask at 25°C . What is the molecular formula of ethylenediamine? (10 points)
5. Consider the following gas-phase equilibrium: $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \leftrightarrow 2\text{HI}(\text{g})$ At a certain temperature, the equilibrium constant K_c is 4.0. Starting with equimolar quantities of H_2 and I_2 and no HI, when equilibrium was established, 0.20 moles of HI was present. How much H_2 was used to start the reaction? (10 points)
6. A mixture of three gases has a pressure of 1380 mmHg at 298 K. The mixture is analyzed and is found to contain 1.27 mol CO_2 , 3.04 mol CO, and 1.50 mol Ar. What is the partial pressure of Ar? (10 points)

Part II Single-choice question (4 points each)

- Which of the following exhibits the most hydrogen bonding?
a. LiH b. CH₄ c. NH₃ d. H₂S e. CH₂F₂
- Which of the following is not likely to exhibit hydrogen bonding?
a. CH₃CH₂OH b. CH₃NH₂ c. H₂O d. NH₂OH
e. (CH₃)₃N
- Which of the following is not planar?
a. BCl₃ b. ClF₃ c. PCl₃ d. XeF₄ e. C₂H₄
- Which of the following molecules has sp³ hybridization and a dipole moment?
a. SiH₄ b. BF₃ c. NH₃ d. BrF₃ e. PCl₅
- In which of the following species is the octet rule violated by the central atom?
a. CH₄ b. SF₄ c. PCl₄⁺ d. SO₂ e. NH₃
- A steel tank contains carbon dioxide at 34 °C and is at a pressure of 13.0 atm. Determine the internal gas pressure when the tank and its contents are heated to 100 °C.
a. 10.7 atm b. 9.4 atm c. 38.2 atm d. 1.9 atm
e. 15.8 atm
- A mixture of three gases has a pressure of 1380 mmHg at 298 K. The mixture is analyzed and is found to contain 1.27 mol CO₂, 3.04 mol CO, and 1.50 mol Ar. What is the partial pressure of Ar?
a. 238 mm Hg b. 302 mm Hg c. 356 mm Hg
d. 1753 mm Hg e. 8018 mm Hg
- A compound with a composition of 87.5 % N and 12.5 % H was recently discovered. What is the empirical formula for this compound?
a. NH₂ b. N₂H₃ c. NH d. N₂H₂ e. N₂H

9. Which one of the following processes is exothermic?

- a. $\text{H}_2(\text{l}) \rightarrow \text{H}_2(\text{g})$ b. $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$
c. $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$ d. $16\text{CO}_2(\text{g}) + 18\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{C}_8\text{H}_{18}(\text{l}) + 25\text{O}_2(\text{g})$
e. $\text{H}_2(\text{g}) \rightarrow 2\text{H}(\text{g})$

10. Consider the reaction $\text{A} \rightarrow \text{products}$. Which of the following plots is consistent with a zero-order reaction?

- a. $[\text{A}]$ plotted against time gives a horizontal, straight line.
b. $\ln [\text{A}]$ plotted against time gives a straight line of negative slope.
c. $1/[\text{A}]$ plotted against time gives a straight line of positive slope.
d. $[\text{A}]$ plotted against time gives a straight line of negative slope.
e. $[\text{A}]$ plotted against time gives a curved line of negative slope, decreasing in magnitude as time increases