

國立成功大學

115學年度碩士班招生考試試題

編 號：101

系 所：環境工程學系

科 目：環境化學及環境微生物學

日 期：0203

節 次：第 2 節

注 意：1. 可使用計算機
2. 請於答案卷(卡)作答，於
試題上作答，不予計分。

Problem 1 (20%)

A carbonate buffer solution is prepared by mixing 2.91×10^{-2} M NaHCO_3 and 4.30×10^{-3} M Na_2CO_3 . Initially, the system is assumed to be a closed system, and only the $\text{HCO}_3^-/\text{CO}_3^{2-}$ buffer pair is considered.

The solution is then **opened to the atmosphere** and allowed to equilibrate with carbon dioxide at a partial pressure of $P_{\text{CO}_2} = 10^{-3.46}$ atm.

Assuming equilibrium with the atmosphere CO_2 and ideal behavior.

Upon opening the buffer solution to the atmosphere, how are the solution pH and the total inorganic carbon concentration (C_T) expected to change? **Explain the direction of these changes.**

Given:

H_2CO_3 $\text{pK}_{a1} = 6.3$, $\text{pK}_{a2} = 10.3$ (25 °C)

Henry's law constant for CO_2 : $K_H = 3.3 \times 10^{-2}$ M/atm

Problem 2 (10%)

When 0.1 mol of each of the following chemicals is added separately to 1.0 L of pure water and allowed to reach equilibrium at 25 °C, the resulting aqueous solutions are formed.

- A. Acetic acid (CH_3COOH)
- B. Ammonia (NH_3)
- C. Sodium hydrogen phosphate (Na_2HPO_4)
- D. Sodium bicarbonate (NaHCO_3)

Rank the solutions in order of increasing pH (from lowest to highest) based on their acid–base behavior. Numerical calculations are not required. Please state your reasoning.

Problem 3 (20%)

Compare and contrast the partition coefficients K_{ow} , K_{oc} , and K_d in terms of their definitions, physical meaning, and environmental applications.

Discuss how each parameter is used to describe the environmental fate and transport of organic contaminants in soil–water systems.

■ 環境微生物學

Problem 4 (25%)

污水下水道混凝土管線經常發生冠狀腐蝕(Crown Corrosion)現象，請以環境微生物學代謝與環境因子(Oxygen/Redox/pH/溫度/停留時間)的視角說明其成因及可能預防方法。(25 分)

Problem 5 (25%)

單段硝化(One-step Nitrification)，亦稱完全氨氧化 Complete Ammonia Oxidation, Comammox)是近年才發現的硝化機制，請比較說明 Comammox 與傳統兩階段硝化(Two-step Nitrification)，並列舉參與各反應的相關微生物屬名(Genus)(20 分)。在低氨、低溶氧、長污泥齡的生物膜系統中，推測哪一途徑更可能占優，並說明理由(5 分)。