國立成功大學

114學年度碩士班招生考試試題

編　號：107

系　所：環境工程學系

科　目：環境化學及環境微生物學

日　期：0210

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。

1. (15 pt) Phosphoric acid is commonly used in the semiconductor industry. As a result, wastewater from a semiconductor company often contains a high concentration of phosphoric acid. Phosphoric acid has three pK_a values covering a wide range: $pK_{a1} = 2.15$, $pK_{a2} = 7.20$, and $pK_{a3} = 12.32$. Currently, the pH of a wastewater is 3.8, and the concentration of phosphorus is 0.2 M. Additionally, the wastewater contains some heavy metal ions that need to be reduced to a desired concentration. To achieve this, the pH must be increased to 10. NaOH solution (1 M) is used to raise the pH of the wastewater.

   Please sketch a curve to show how the pH changes in response to the amount of NaOH added to the solution. Hint: On the y-axis, plot the pH of the solution. On the x-axis, plot the amount of NaOH (in moles or milliliters) added to the wastewater.

2. (15 pt) The aqueous concentration of tetrachloroethene (TCE) is measured to be 35 mg/L. The water, at a temperature 25°C, is in contact with a dense non-aqueous phase liquid (DNAPL) containing TCE. Assuming that Henry's law and the Raoult's law are valid, estimate the mole fraction of TCE in the DNAPL. At 25°C Henry's law constant for TCE is 11.68 atm-L/mol and the vapor pressure of pure TCE is 0.0977 atm.

3. (20 pt) Anaerobic biotransformation of chlorinated organics such as chloroform can be modeled using a second-order rate expression. This process, typically referred to as cometabolism, assumes that the concentration of bacteria remains constant. If the second-order rate coefficient is 0.005 L/mg-day and the concentration of bacteria is 100 mg/L, calculate how many days it will take for an initial concentration of 1 mg/L chloroform to be reduced to 1 μg/L (a 99.9% reduction).

環境微生物學

4. 非培養方法（culture-independent method）可以用來快速監測污水中病原微生物分佈與動態。請詳述如何利用非培養方法分析污水樣本中 SRAS-CoV-2(又稱 COVID-19)病毒的數量。(10 分)

5. 生物復育(Bioremediation)常被用作整治有機氯化合物污染的方法。請詳細說明環境好氧菌 *Methylocystis* 與絕對厭氧菌 *Dehalococcoides* 分解三氯乙烯的微生物學原理，以及如何分別利用這兩類菌群整治地層三氯乙烯汙染。(20 分)

6. 請說明氮循環重要反應 Anaerobic ammonium oxidation (Anammox)與相關菌群之生長能量來源與碳源，以及如何應用 Anammox 方法處理廢水? 使用這個方法有何優缺點? (20 分)