

系所組別： 環境工程學系甲組

考試科目： 環境化學及環境微生物學

考試日期：0219 · 節次：2

※ 考生請注意：本試題 可 不可 使用計算機

Problem Sets for Environmental Chemistry

- 一、 **Water Softening.** The water in table below is to be softened by lime softening. How many kgs of lime must be added to treat 50 m^3 of the water and how many kgs of calcium carbonate will be precipitated? (10 pts).

Concentration (mg/L)			
Cation		Anion	
Ca^{2+}	100	HCO_3^-	270
Mg^{2+}	5	Cl^-	50
Na^+	35	SO_4^{2-}	45
		NO_3^-	10

- 二、 **Solubility.** The dimensionless Henry's constant for trichloroethene (TCE) at 25°C is 0.4. A sealed glass vial is prepared that has an air volume of 4 mL overlying an aqueous volume of 36 mL. TCE is added to the aqueous so that initially it has an aqueous phase concentration of 100 ppb. After the system equilibrates, what will be the concentration (in units of $\mu\text{g/L}$) of TCE in the aqueous phase. (10 pts).
- 三、 **Chemical Reaction Kinetics.** Nitrogen oxide (NO_2) concentrations are measured in an air-quality study and decreased from 5 ppm to 2 ppm in 4 minutes with a particular light intensity. (a) what is the first-order rate constant for this reaction? (b) what is the half-life of NO_2 during this study? (c) what would the rate constant need to be changed to in order to decrease the time required to lower the NO_2 concentration from 5 ppm to 2 ppm in 1.5 minutes? (15 pts).
- 四、 **Membrane Filtration.** Please define the cut-off sizes (in μm) for the following membranes: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO). If you are designing membrane filtration systems for the following contaminants, what types of membrane you will use for the optimal operation (considering contaminant removal efficiency, fouling issues, and cleaning frequency). (1) virus, (2) *Cryptosporidium parvum* and *Giardia lamblia* (3) Hardness, (4) endotoxins produced by microalgae. (15 pts).

(背面仍有題目,請繼續作答)

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五、[Terminology] Please briefly explain or describe the items below
(3% each, a total of 18 %)

- (a) Sludge bulking
- (b) Anammox reaction
- (c) Co-metabolism
- (d) Quorum sensing
- (e) *In-situ* bioremediation
- (f) Indicator microorganism

六、[Waste/Wastewater Microbiology] Anaerobic digestion is an important biological treatment process in domestic wastewater treatment plant. Waste sludge from the activated sludge system and from the primary treatment units is required further treated by anaerobic digestion before final disposal.

- (a) The microbiological reactions in the anaerobic digestion are usually classified into four stages. Please explain the reactions in the stages using the degradation of polysaccharide material into the final products as an example. (12 %)
- (b) It is considered that the anaerobic digestion may be a “Environmental Green biotechnology”. Please provide your comments on this as much as you can. (10 %)

七、[Microbiological Tools] A graduate student used the reverse osmosis (RO) module for the study of water purification. After running for a period, she encountered a biofouling problem, namely accumulation of microorganisms on the surface of the RO membrane. She wants to understand what kinds of microorganisms present on the surface of the RO membrane. Based on the viewpoint of Environmental Microbiology, please suggest a studying approach for her. (10 %)