環境化學部份 50%

(一)10% Figure out an acidified titration curve of 1,060mg/L Na_2CO_3 solution with 0.02N-H_2SO_4 standard solution；Then point out 2 equilibrium points and 2 end points of CO_3^{-2}，HCO_3^- and H_2CO_3* in the pH vs mL titrant diagram.

(二)10% Figure out a BOD curve (mg/L oxygen uptake vs time) of a mixed substrate solution (Glucose 180mg/L + NH_4^+-N 28mg/L)；Then differentiate the amount of BODc and BOD_N during ten days of oxic biodegradation by a mixed culture of aerobic bacteria.

(三)10% Write down the standard operation procedure (SOP) of SS and VSS water quality examination with weight method.

(四)10% How much mg/L of nutrient pollutants (NH_4^+-N and PO_4^{-3}) will present in 3 kinds of eutrophicated water：pig-house wastewater，domestic sewage and polluted water supply，respectively.

(五)10% You are able to smell at less 3 kinds of awful odor (air pollutants) in the biogas emission from a swine sludge digestor (anaerobic biodegradation) in the big farm. Write out one organic odor and two inorganic odors， and how to measure these odors.

(背面仍有題目,請繼續作答)

Problem Sets for Environmental Microbiology

6. **Microbial metabolism.** "Why" and "how" do microorganisms oxidize organic carbon to CO_2 and H_2O under aerobic conditions? Please explain it as clear as possible using the example of aerobic oxidation of glucose through the EMP pathway (glycolysis), the TCA cycle, and the electron transfer chain (ETC). (15 pt)

7. **Mathematical models for microbiology.** Please clearly explain, compare, and contrast the models developed by L. Michaelis and M. Menten in 1913 and J. Monod in 1940s, respectively. (6 pts)

8. **Microbial growth kinetics.** Consider growing two microorganisms in a CSTR with influent glucose concentration (S_0) of 2000 mg/L. Microorganism 1 has the maximum specific growth rate (μ_1^{max}) of 0.5 $h^{-1}$and Monod affinity constant (Ks_1) of 150 mg/L and Microorganism 2 has the maximum specific growth rate (μ_2^{max}) of 0.4 $h^{-1}$and Monod affinity constant (Ks_2) of 50 mg/L, respectively. The biomass yield (Y) for both microorganisms is 0.3 and biomass decay (k_d) is negligible. Please answer the following questions with detailed explanations. (a) Operate the CSTR at 15 hours of HRT for more than 1000 days and observe that the effluent glucose concentration (S) is 80 mg/L, calculate the biomass concentrations for microorganisms 1 and 2 (b) Operate the CSTR at 8 hours of HRT for more than 1000 days and observe that the effluent glucose concentration (S) is 770 mg/L, calculate the biomass concentrations for microorganisms 1 and 2 (c) Operate the CSTR at 1.5 hours of HRT for more than 1000 days, calculate the biomass concentrations for microorganisms 1 and 2 and the effluent glucose concentration (S)? (12 pt).

(Hint: effluent biomass concentration $X = \frac{Y(S_0 - S)}{(1 + k_d\theta)}$)

9. **Cometabolism.** Please clearly define and explain the terminology of cometabolism using an example in environmental engineering. (7 pts)

10. **Tools to study microbial ecology.** The start of 21st century marks a period of revolutionary advancement in our ability to study microbial ecology. Please list 3 traditional and 3 molecular tools that can be used to study microbial ecology and comment on their advantages and disadvantages in studying microbial ecology. (10 pts)