

系所組別：環境工程學系丙組

考試科目 普通化學

考試日期：0307，節次：1

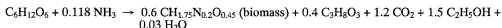
※ 考生請注意：本試題  可  不可 使用計算機

一 **Acid-Base Chemistry.** Please find the pH value of a solution containing 0.01M acetic acid and 0.02M sodium acetate. If sufficient amount of NaOH (achieve 0.001M) is added to the above acetic acid/sodium acetate solution, what the final pH value will be for this new solution? (acetic acid  $pK_a=4.74$ ) (20 pts)

二 **Solubility.** Polychlorinated biphenyls (PCBs) are a mixture of over 200 individual compounds and these pollutants have been spread widely throughout the environment. If the concentration of PCB-105 (one of the individual compounds) was  $300 \text{ pmole/m}^3$  in the air above a large lake and the concentration in the surface water of the lake was  $100 \text{ pmole/m}^3$ , would this compound tend to move from the water into the air or from the air into the water? Please clearly explain your answer using the following information: The Henry's law constant for this compound is  $10 \text{ mole/L-atm}$  and assume the air/water temperature is  $25^\circ\text{C}$ . (20 pts).

三 **Chemical Reaction Kinetics.** Nitrogen oxide ( $\text{NO}_2$ ) 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  $\text{NO}_2$  during this study? (c) what would the rate constant need to be changed to in order to decrease the time required to lower the  $\text{NO}_2$  concentration from 5 ppm to 2 ppm in 1.5 minutes? (25 pts).

四 **Chemical Reaction Stoichiometry** Yeasts are used to convert glucose to produce biomass, glycerol, and ethanol by the following overall reaction under anaerobic conditions.



Calculate (1) the theoretical biomass yield in g of biomass per g of glucose, (2) the ethanol yield in g of ethanol per g of glucose. Please comment on how to maximize the ethanol yield through this biochemical reaction (10 pts)

五 **Chemical Reaction Thermodynamics** Answer the following questions regarding the biodegradation of phenol:

(a) Construct a half reaction for the oxidation of phenol ( $\text{C}_6\text{H}_6\text{O}$ ) to  $\text{CO}_2(\text{g})$  (7 pt)

(b) Determine  $\Delta G^\circ$  for the reaction (8 pt)

(c) For anaerobic conditions and  $\text{pH} = 7$ , is the conversion of phenol to methane gas ( $\text{CH}_4(\text{g})$ ) thermodynamically favorable? (10 pt)

|                            | $\text{C}_6\text{H}_6\text{O}(\text{aq})$ | $\text{H}^+(\text{pH}=7)$ | $\text{CO}_2(\text{g})$ | $\text{H}_2\text{O}(\text{l})$ | $\text{CH}_4(\text{g})$ |
|----------------------------|---|---------------------------|-------------------------|--------------------------------|-------------------------|
| $G_f^\circ(\text{KJ/mol})$ | -47.5                                     | -39.87                    | -394.38                 | -237.18                        | -50                     |