(一)解釋名詞：每題3分(15%)

1. Xenobiotic compound
2. di-auxic growth
3. AMES test
4. co-metabolism
5. microbial indicator

(二)問答題：(35%)

1. 何謂生物能量三劣曲？請以生物化學及能能轉換之觀點，分別敘述其過程及所需條件。(7%)
2. 以圖示自然界之碳，氮循環，並列出各生化反應名稱及參與反應之微生物名稱。(8%)
3. 何謂光能營(photo-autotrophic)，化學自營(chemo-autotrophic)及化學異營(chemo-hetorotrophic)微生物？說明其利用碳，氮及能量之異同處，並各舉一代表菌屬說明其在環境中所扮演之角色(7%)
4. 何謂 微生物生長？微生物在密閉系統中有其一定之生長模式，請繪圖表示並說明之，並列舉三种常用來表示微生物活性之測定方法，要述之。(7%)
5. 微生物之基因傳送(gene transfer)方式有那幾種，請要述之，何謂基因重組(gene recombination)？簡述其過程。(6%)

(背面仍有題目，請繼續作答)

(三)

一. 9% Based on the concept of thermodynamics, discuss the enthalpy change (ΔH), entropy change (ΔS), and free energy change (ΔG) after the biodegradation of organic compounds.

二. 9% Explain why the caustic soda water softening process generates less chemical sludge than the lime-soda ash water softening process.

三. 8% Explain why the microorganisms found in the aeration tanks of the activated sludge system are negatively charged.

四. 8% Calculate the pH of a buffer solution containing 0.01 M acetic acid a nd 0.02 M sodium acetate. Then calculate the pH after enough NaOH is added to give a concentration of 0.001 M. (Given: pK_a's value of acetic acid = 4.74)

五. 8% Which of the following acids can be used for the titration of alkalinity to methyl orange end point (pH≒4.2). What criterion determines their use?

Acid	pK_a
NH_4^+	9.3
$H_2CO_3^*$	6.3
HCl	–3.0
H_3PO_4	1.96

六. 8% What are the common primary standards that can be used for standardizing (1) acids, (2) bases, (3) reducing agents, and (4) oxidizing agents?