

Part I.

環境工程化學 (50%)

1. According to Chick's law, the rate of kill of bacteria by chlorination follows first-order reaction kinetics. Assuming this to be true, how much contact time is required to kill 99.5% of the bacteria with a chlorine residual of 0.1 mg/L, if 80% are killed in 2 minutes with this residual? (10%)
2. Calculate the activity coefficients and the activities of each ion in a solution containing 0.01 M $MgCl_2$ and 0.02 M Na_2SO_4 . (10%)
3. Explain precisely the main principles of the "Third Law of Thermodynamics". (5%)
4. List key factors that affect the 5-day BOD measurement. (5%)
5. A study was made to evaluate the constants so that the Michaelis-Menten relationship could be used to describe waste utilization by bacteria. It was found that 1 g of bacteria could decompose the waste at a maximum rate of 20 g/day when the waste concentration was high. Also, it was found that this same quantity of bacteria would decompose waste at a rate of 10 g/day when the waste concentration surrounding the bacteria was 14 mg/L. What would be the rate of waste decomposition by 3 g of bacteria if the waste concentration were maintained at 6 mg/L? (10%)
6. A buffer solution has been prepared by adding 0.2 M of acetic acid ($pK_A = 4.7 @ 298K$) and 0.1 M of acetate. The pH of the solution has been adjusted to 5.0 by addition of NaOH. How many mol/L of NaOH is required to increase the pH to 5.2? (10%)

part II

I. Answer the following questions : (20 %)

1. From the biological and chemical points of view, describe the differences in the nitrifying and the denitrification bacteria. (6%)
2. What are the " archaeobacteria " ? Briefly describe the major differences from the " eubacteria " : (6%)
3. Discuss the possible reasons, a culture might have a long lag phase after inoculation in laboratory. (4%)
4. Calculate the generation time of a culture that increases from 1×10^2 to 4×10^8 cells in 24 hrs. (4%)

II. Briefly describe the major characteristics and roles of the following microorganisms of environmental importance : (15%)

1. Giardia lamblia
2. Zoogloea ramigera
3. Methanogens
4. Photosynthetic bacteria
5. Algae

III. Describe the following terms in microbiology : (15%)

1. Coliforms
2. Diauxic growth
3. Transduction
4. Mutation
5. Heterofermentation