

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. **Sedimentation.** (A) Please clearly describe four principles of particle settling used in sedimentation units and their application in water and wastewater treatment processes. (15 pts) (B) The following table lists settling velocities (V_s) for suspended particles in a wastewater and their corresponding weight percentages. Please calculate average particle removal efficiency for a sedimentation tank with a surface loading rate $Q/A = 30 \text{ m}^3/\text{m}^2 \cdot \text{day}$. (10 pt)

V_s (m/day)	10	15	20	25	≥ 30
Weight %	10	15	15	30	30

2. **Membrane Filtration.** A hollow-fiber membrane module contains 5760 fibers. The fibers are 1.87 m long with an outside diameter of 1.3 mm and inside diameter of 0.7 mm. Calculate the water production from one module if the volumetric flux is $75 \text{ L}/\text{m}^2/\text{hr}$ and the flow direction is (1) outside in (8 pts) and (2) inside out (7 pts).

3. **Chlorination.** The results of a chlorine demand tests on a raw water at 20°C are given in the following table. (a) Sketch the chlorine demand curve (6 pt) (b) What is the breakpoint chlorine dosage? (7-pt) (c) What is the chlorine demand at a chlorine dosage of $1.2 \text{ mg}/\text{L}$? (7 pt).

Sample	Chlorine Dosage, mg/L	Residual Chlorine after 10 Min of Contact, mg/L
1	0.2	0.19
2	0.4	0.37
3	0.6	0.51
4	0.8	0.50
5	1.0	0.20
6	1.2	0.40
7	1.4	0.60
8	1.6	0.80

4. **Activated Sludge System.** A conventional activated sludge system treats $11,000 \text{ m}^3/\text{d}$ of wastewater with a BOD of $180 \text{ mg}/\text{L}$ in an aeration tank with a volume of 3400 m^3 . The operating conditions are an effluent suspended solids of $20 \text{ mg}/\text{L}$, an MLSS concentration maintained in the aeration tank of $2500 \text{ mg}/\text{L}$, and an activated sludge wasting rate of $160 \text{ m}^3/\text{d}$ containing $8000 \text{ mg}/\text{L}$ of MLSS. Calculate the aeration period, volumetric BOD loading, F/M ratio, and sludge age. (20 pts).
5. **Anaerobic Digestion.** Please briefly describe fundamentals of anaerobic decomposition organic wastes including mechanisms, metabolic pathways, and microbiology, as well as important design and operational parameters for sludge digestion. (20 pts)