

系所組別：環境工程學系甲組

考試科目：衛生工程

考試日期：0307，節次：1

※ 考生請注意：本試題 可 不可 使用計算機

1. (1) For solids impurities existed in raw water for public water supply, give the name of the three groups of solids, based on their size, i.e.  $< 1 \text{ nm}$ , between  $1 \text{ nm}$  and  $1 \text{ um}$ , and  $> 1 \text{ um}$ .  
(2) Name the treatment units that can be used to remove each group of the solids, and also explain their operational principle. (15%)
2. Water purification plant A has capacity  $5,000 \text{ m}^3/\text{day}$ . Postchlorination is used for disinfection. If the chlorine dosage and total residual chlorine at the breakpoint are  $5.4$  and  $0.4 \text{ mg/L}$ , respectively. Assume the required free residual chlorine of the treated water leaving the plant is  $0.8 \text{ mg/L}$ . Calculate the required chlorine dosage, the chlorine demand at that dosage, and also the amount of chlorine (kg) needed per day. (10%)
3. For membrane process, (1) What is molecular weight cut-off (MWCO)? (2) What are the differences between spiral wound and hollow fiber modules? (3) Pressure-driven membrane processes can be divided into two groups, namely MF & UF and NF & RO, explain the differences between these two groups, as far as impurities removal is concerned. (15%)
4. A baffled channel flocculator, with effective volume of  $200 \text{ m}^3$ , is to treat  $7,800 \text{ m}^3/\text{d}$  of water. Assume the water level difference of inlet and outlet is  $80 \text{ cm}$ . Calculate the mean velocity gradient (G value in  $\text{sec}^{-1}$ ). Assume the mass density of water is  $1,000 \text{ kg/m}^3$ , dynamic viscosity is  $10^{-3} \text{ kg/(m-sec)}$ . (15%)
5. A completely mixed activated-sludge plant is to treat  $10,000 \text{ m}^3/\text{d}$  of domestic wastewater. The influent to the aeration tank has a  $\text{BOD}_5$  of  $300 \text{ mg/L}$ , which must be reduced to  $30 \text{ mg/L}$  before discharge. The MLSS in the aeration tank is to be kept at  $3,000 \text{ mg/L}$ , while the mean cell residence time of the system is  $8 \text{ d}$ . Assume the cell yield coefficient is  $0.7 \text{ kg biomass/kg BOD utilized}$ , and endogenous decay coefficient is  $0.04 \text{ d}^{-1}$ . The thickened sludge in the final clarifier is expected to be  $12,000 \text{ mg/L}$ . Determine
  - (1) The volume of the aeration tank.
  - (2) The BOD volumetric loading and F/M ratio
  - (3) The sludge recirculation ratio.
  - (4) The mass and volume of solids need to be wasted per day. (20%)  
(Hint:  $1/\theta_c = (Y(S_0 - S)) / (\theta X) - K_d$ )
6. (1) Assume a pumping system has a total dynamic head (H) =  $40 \text{ m}$ . The local atmospheric pressure is  $101.3 \text{ kN/m}^2$ , vapor pressure of water  $3.17 \text{ kN/m}^2$ , and total head loss (friction and minor) of the suction pipe is  $0.1 \text{ m}$ . Assume the water density is  $1,000 \text{ kg/m}^3$ . If  $\text{NPSH}_{\text{required}} = 0.3H$ , and, for safety reason, the  $\text{NPSH}_{\text{available}}$  should be at least  $1 \text{ m}$  higher than  $\text{NPSH}_{\text{required}}$ . What is the minimum static suction head required?  
(2) Give the reasons why we need to care about NPSH when design a pumping system. (15%)  
(Hint:  $\text{NPSH}_{\text{available}} = h_s + P_{\text{atm}}/\gamma - P_{\text{vap}}/\gamma - h_f$ )
7. What are the major hydraulic differences between the flow in the pipeline of a water supply distribution system and that of a sewer system. Also explain the rationale behind these differences. (10%)