

1.  $LD_{50}$  is used for measuring toxicity of a compound. (5 points)  
If compound A has  $LD_{50} = 5 \mu\text{g/L}$  and compound B has  $LD_{50} = 20 \text{ ng/L}$ , which compound (A or B) is more toxic?
2. (continue from Question 1) What are the problems of this toxicity measuring method? (2 correct answers) (5 points)
  - (a) It neglects the long term (chronic) effect
  - (b) It is not as accurate as  $LC_{50}$
  - (c) It neglects the synergistic effect with other toxins
  - (d) It can only be tested on the fish.
  - (e) It can only be tested on mice.
3. Which of the following statement about source water is NOT true? (5 points)
  - (a) Groundwater compare to surface water has less microbial contaminant
  - (b) Surface water contains more humic substance which enhance the performance of rapid sand filters
  - (c) The major issues about reclaim water are microbial and chemical contaminants
  - (d) Groundwater contains less humic substances.
4. In sludge digestion, which of the following can be recovered as an energy source? (5 points)
  - (a) Methane; (b) Carbon dioxide; (c) Scum; (d) Carbon monoxide.
5.  $\text{H}_2\text{O}$  is a (5 points)
  - (a) polar molecule
  - (b) non-polar molecule
  - (c) both polar and non-polar molecule
  - (d) neither of the above
6. In a clean lake environment (not heavily polluted), compound X (Molecular Weight = 254.3,  $\text{pK}_a = 4.5$ ,  $\text{Log Kow} = 3.2$ ) will mostly exist in its (5 points)
  - (a) Protonated form
  - (b) Deprotonated form
  - (c) Half protonated and half deprotonated form
  - (d) Neither of the above
7. A small industrial wastewater treatment plant is located next to a river as shown below. The treated wastewater is discharged into the river. In the wastewater treatment plant, a completely mixed flow reactor (CMFR) is used to remove the pollutant. The removal follows a first order reaction. Following details are known:

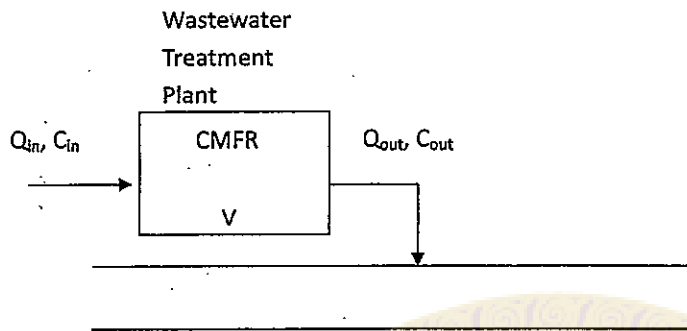
Volume of the CMFR,  $V = 100 \text{ L}$

Wastewater inflow rate ( $Q_{in}$ ) = Wastewater outflow rate ( $Q_{out}$ ) = 50 L/day

Inflow concentration,  $C_{in} = 5000 \text{ mg/L}$

First order rate constant,  $k = 10 \text{ L/mg-day}$

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- (a) Use the symbols given above to derive the detailed mass balance equation of the CMFR. Describe any assumption you use. (7 points)
  - (b) Determine the steady-state concentration of the pollutant in the outflow of the treatment plant using the details given above. (7 points)
  - (c) It is known that the discharge standard for this pollutant is 150 mg/L. Can the wastewater treatment plant meet the standard? If not, what can be done to meet the standard? (6 points)
8. A standard BOD test was done for domestic wastewater at 20°C. 300 mL BOD bottles were used. It is known that the initial DO is the saturated DO concentration at 20°C
- (a) Draw a typical BOD vs. time curve for a time span of 30 days. Describe the dominant processes that occur at different stages in the curve. (10 points)
  - (b) Domestic wastewater is discharged into a river after treatment. It is known that the treated wastewater still contains some BOD-causing substances but meets the wastewater discharge standard and will not cause significant adverse effects on aquatic life. Draw a "schematic" profile of dissolved oxygen (DO) concentration as a function of downstream location (x) up to the point where all BOD-causing substances are consumed. Describe the important processes regulating the DO concentration in the profile. (10 points)
9. 旋風分離器(CYCLONE)是空氣汙染粒狀物控制重要方法之一，說明其粒狀物控制機制(MECHANISM)，並繪圖說明控制效率與粒狀物粒徑的關係(分級效率圖，GRADE EFFICIENCY) (10 points)
10. 說明我國空氣品質標準內容，特別注意懸浮微粒的部分，不只一種。(10 points)
11. 以相關大氣化學反應機制說明臭氧層破壞的主要原因。(10 points)

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