

1. Please explain the following terms and their related environmental implications. (15 pts)
 - (1) Bioconcentration Factor (BCF)
 - (2) Zero Liquid Discharge (ZLD)
 - (3) Solid Recovered Fuel (SRF)

2. Find the equilibrium concentration of phosphate ions in pure water caused by the solid aluminum phosphate (AlPO_4). Express the answer both in units of mol/L and mg/L . (5 pts)
$$\text{AlPO}_{4(s)} \leftrightarrow \text{Al}^{3+} + \text{PO}_4^{3-} \quad \text{with } K_{sp} = 10^{-22}$$

3. Please plot a typical dose response curve and explain median lethal dose (LD_{50}) (5 pts)

4. A completely mixed batch reactor (CMBR) is designed to remove an input flow of $0.10 \text{ m}^3/\text{s}$ of a pollutant with a concentration of 30 mg/L . The effluent from the reactor must have pollutant concentration of less than 5 mg/L . How large must the reactor be? (10 pts)
 - (1) If the pollutant is nonconservative with a zero-order decay rate ($0.80 \text{ mg}\cdot\text{L}^{-1}\cdot\text{day}^{-1}$)
 - (2) If the pollutant is nonconservative with a first-order decay rate (0.50 day^{-1})

5. (1) What is the difference between a primary and a secondary wastewater treatment plant. (5 pts)
(2) If you need to reclaim the secondary effluent from a municipal wastewater treatment plant, sketch a flow diagram and describe all the processes to meet the water quality standard of high-tech industry. (10 pts)

6. Please define and explain the followings. (15 pts)
 - (1) Sustainable Development
 - (2) Green Chemistry
 - (3) Circular Economy

7. Please explain the differences between sanitary landfill, sealed landfill and stabilized landfill. (10 pts)

8. Selective catalytic reaction and non-selective catalytic reaction are common methods to deal with nitrogen oxides. Please explain the differences and their chemical reactions respectively. (10 pts)

9. A factory uses a coal-fired boiler as a power source. The emission rate for exhaust in the chimney is $2,000 \text{ m}^3/\text{min}$, and the temperature and carbon dioxide concentration is 150°C and 12% , respectively.
 - (1) How much carbon dioxide does the coal-fired boiler emit in a year? (10 pts)
 - (2) If the factory wants to reduce carbon dioxide emissions, please propose 2 feasible methods and explain their principles. (5 pts)

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