

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

Water Quality Management (25%)

1. Regarding the eutrophication in marine ecosystem, is the growth rate of algae dominated by concentration changes of phosphate or nitrate? Why? (6 %)
2. A leaking underground storage tank has discharged the solvent trichloroethylene (TCE) into groundwater. A water well used for drinking is 120 m downgradient from the leaking tank. To ensure the safety of the water supply, the tank is removed to stop the source, and a monitoring well is drilled halfway between the water well and the solvent discharge. The difference in hydraulic head between the source and monitoring well is 35 cm (with the head in the monitoring well lower). A site investigation shows the subsurface aquifer material consists primarily of medium sand. How long does it take groundwater underneath the leaking tank to reach the monitoring well? Assume the TCE moves at the same velocity as the groundwater. For medium sand, the hydraulic conductivity K is 12 m/day, and the porosity η is 0.39 (19 %).

The relation between average velocity and Darcy velocity: $v_a = \frac{v}{\eta} = -\frac{K}{\eta} \frac{dh}{dl}$

Air Quality Control (25%)

3. What are the Air Quality Index (AQI) and its classification levels in Taiwan? Please indicate the six air pollutants that AQI considers (12%).
4. A baghouse that employs a shaker collection method is designed to remove 99.75% particles of an incoming stream originated from a cement plant. What fabric area is required for the baghouse if it treats 21000 ft³/min of polluted air? How many bags are required if the bags are cylindrical and are 6 inches in diameter and 20 ft long? Assume the filter manufacturer has specified a woven fabric for a gas-to-cloth ratio of 2.0 ft/min (13 %).

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Waste and Resource Management (25%)

5. To reduce generation of waste and boost circular economy, the EPA of Taiwan promotes the 6R strategies, which includes Redesign, Land Reclamation, Energy Recovery, and other 3R strategies. What are the rest 3R strategies (6%)?
6. A refuse-derived fuel (RDF) comprises 60% of mixed paper, 30% of mixed plastic and 10% textile. Assume it is dried before combustion. Determine the volume of air (in L at 20°C), 1 atmosphere pressure that is required to combust 1 kg of RDF. Please refer to the table below for the C H S O in the waste (19%).

Table 1. Common Chemical Characteristics of Solid-Waste Components

	Carbon (% by dry mass)	Hydrogen (% by dry mass)	Sulfur (% by dry mass)	Oxygen (% by dry mass)
Paper (mixed)	43.4	5.8	0.2	44.3
Plastics(mixed)	60	7.2	0	22.8
Textiles	48	6.4	0.2	40

Wastewater Treatment (25%)

7. In a wastewater treatment plant, the suspended solids concentration is 220mg/L in the plant influent; 4000 mg/L in the primary sludge, 15000 mg/L in the secondary sludge, and 3000 g/L exiting the aeration basin. The concentration of the total dissolved solids in the plant influent is 300 mg/L, and the concentration total dissolved solids exiting the aeration basin is 3300 mg/L. The BOD₅ is 150 mg/L measured after primary treatment and 15 mg/L exiting the plant. If the F/M ratio is 0.33 kg BOD₅/ kg MLSS-day, estimate the hydraulic retention time of the aeration basing if the total plant flow is 20000 cubic meters/day (16%).
8. Please specify three kinds of tertiary water treatment processes with the target pollutants and the required chemical additives or physical mechanism to react or remove the pollutants (9%).