

國立清華大學 100 學年度碩士班入學考試試題

系所班組別：生醫工程與環境科學系乙組(環境分子科學組) (0526)

考試科目 (代碼)：環境科學與工程 (2602)

共 2 頁，第 1 頁 *請在【答案卷、卡】作答

- (1) Please define and give one example to explain the following terms. (30%)
- | | |
|--------------------------|-------------------------|
| [A] Carbon Sequestration | [B] Emerging Pollutants |
| [C] Schultz-Hardy Rule | [D] Lapse Rate |
| [E] Biodiversity | [F] Low Carbon Energy |
- (2) The composition of digester gas from the anaerobic digestion of wastewater sludge is 68% CH₄, 30% CO₂, and 2% H₂S. If 1,000 kg of the gas mixture is stored in a tank at a pressure of 300 kPa at 60°C, please calculate the partial pressure of each component present at 25°C. (5%)
- (3) (a) Please define hardness and its environmental meaning in water treatment. (5%)
- (b) Form the water analysis presented below, please determine the amount of lime and soda needed to soften the water. (10%)
- | | |
|-------------------------------|--|
| Ca ²⁺ = 95.2 mg/L | CO ₂ = 19.36 mg/L |
| Mg ²⁺ = 13.44 mg/L | HCO ₃ ⁻ = 242 mg/L |
| Na ⁺ = 26 mg/L | SO ₄ ²⁻ = 53.77 mg/L |
| Cl ⁻ = 67.8 mg/L | |
- (4) (a) Explain Deutsch formula used in electrostatic precipitation (ESP) (5%)
- (b) Please use Deutsch formula to determine the collection efficiency of the ESP described below for a particle diameter of 154 μm having a draft velocity of 0.184 m/s. What is the effect of reducing the plate spacing to one-half of its current value and doubling the number of plates? (10%)
- Dimensions of ESP:
- Height = 7.32 m
- Length = 6.10 m
- Number of passages = 5
- Plate spacing = 0.28 m
- Gas flow rate = 19.73 m³/s

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- (5) A 100-MW coal-burning electricity generation station operates at 33% efficiency burning coal containing 5% ash and 2% sulfur. Assume a coal heat content of 30 kJ/g. If 95% of the ash and 50% of the sulfur are trapped before emission from the stack, please calculate
- (a) the emission rate to the atmosphere of ash and sulfur (in SO_2) (in g/s) (5%)
 - (b) the volume of SO_2 generated at 20 °C and atmospheric pressure. (5%)
 - (c) If the sulfur is emitted into an urban area of stagnant air 500 m high and 5 km in diameter. How long it would take for the SO_2 concentration to reach the level of 0.3 ppm? (5%)
- (6) Biodegradation is one of the most often used methods to remove hazardous compounds in the environment. Several physical and chemical characteristics of chemicals including hydrophobicity, solubility, volatility, and affinity for lipids are involved in determining the amenability of a hazardous waste compound to biodegradation. Please use benzene as an example, suggest and discuss ways in which each one of those factors mentioned above might affect biodegradability under aerobic conditions. (10%)
- (7) (a) Calculate the volume of bacterial biomass in a gram of soil, given the following assumptions: (5%)
- Soil bacteria are small sphere of diameter 0.5 μm , the total number of bacteria is 10^8 cells/g, and the bulk density of soil is 1.4 g/cm^3 .
- (b) If the porosity of the soil is 50%, what percentage of the pore space is occupied by bacteria? (5%)