(1) Please compare the following terms and briefly explain their environmental meanings (50%)

    (A) Pollutants *vs* Contaminants

    (B) Maximum Contamination Level *vs* Maximum Contamination Level Goal

    (C) Primary *vs* Secondary air quality standard

    (D) Oxidative Phosphorylation *vs* Substrate Level Phosphorylation.

    (E) Nitrification *vs* Denitrification.

    (F) Antagonism *vs* Synergism.

    (G) Priority Pollutants *vs* Hazardous Air Pollutants

    (H) Flocculant Settling *vs* Hindered Settling.

    (I) Air Sparging *vs* Permeable Reactive Barrier.

    (J) Estuary *vs* Wetland.

(2) An analysis of water from a surface stream yields the following results

    Ca^{2+} = 60 mg/L HCO_3^- = 115 mg/L

    Mg^{2+} = 18 mg/L SO_4^{2-} = 108 mg/L

    Na^+ = 7 mg/L NO_3^- = 10 mg/L

    K^+ = 20 mg/L Cl^- = 20 mg/L

    (A) If an error of 7 percent is acceptable, should the analysis be considered complete? Discuss the possible reasons if the error is unacceptable (5%)

    (B) Please calculate the weight of lime and soda ash needed to removal the hardness in a liter of water. (10%).

(3) A typical side-loaded compactor truck has a capacity of 5 m³. Estimate the maximum number of residences it can serve per week by assuming 3 trips per day and 4 days a week. (7%)

(4) A wastewater contains trichloroethylene (TCE) with an initial concentration of 1200 μg/L.

    (A) Please propose a chemical process that can effectively remove TCE in wastewater. (8%)

    (B) According to the strategy you proposed, a batch reactor is used to treat TCE. The reaction of TCE is found to be first order, and the rate constant is 0.25 d⁻¹. Please determine the hydraulic retention time (HRT) required to convert 90% of TCE. (5%)

    (C) Determine the HRT again if plug flow reactor is used to treat TCE. (5%)

(5) Please answer the following questions:

    (A) Please derive the Stokes equation. (6 %)

    (B) What is the settling velocity of a particle having a Stokes diameter of 10 μm and a density of 2.5 g/cm³ in air at 1.0 atm and 0°C. The density and viscosity of air at 0 °C are 1.29 g/L and 170.8 μ poise, respectively. (4%)