※ 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。

1. Please discuss which of the following is associated with the corrosion of sanitary. Please write the chemical reactions to illustrate your answer. (10%)

    a) BOD

    b) FOG (fats, oils, grease)

    c) H_2S

    d) NH_3

2. For coal-fire steam electric power plants, control of SOx emissions is the most commonly achieved by which of the following technique? Please illustrate your answer with the properties of the technique you chose for full credits. (15%)

    a) Lime scrubbing

    b) Catalytic conversion

    c) Electrostatic precipitation

    d) Carbon Adsorption

3. A chemical plant generates a waste solvent (400 m^3/day) mixed with tetrahydrofuran (for component 1) and cis-1,2-dichloro-ethene (for component 2). Temperature against composition diagram for the system terahydrofuran-cis-1,2-dichloroethene at 101.325 kPa (1 atm) is shown in the figure below.

The mole fraction of the two chemicals were analyzed. Their mole fractions are $x_1 = 0.78$ and $x_2 = 0.22$, respectively.

(1) Is it possible to treat this waste solvent by distillation to obtain pure tetrahydrofuran? If your answer is yes, please describe the detail processes to obtain it. (10%)

(2) Is it possible to treat this waste solvent by distillation to obtain pure cis-1,2-dichloro-ethene? If your answer is yes, please describe the detail processes to obtain it. (10%)
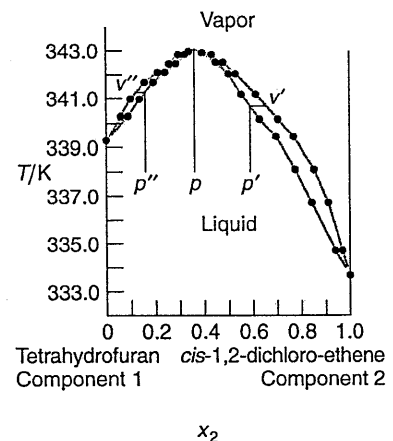
4. A groundwater sample contains the following ions: Na^+ 0.02M; Mg^{2+} 0.015 M; Ca^{2+} 0.01M; K^+ 0.001M; Cl^- 0.025M; HCO_3^- 0.001M; NO_3^- 0.002M; and SO_4^{2-} 0.012M

Complicate calculation is not necessary for this question. Please approximately estimate the pH value (or pH range) of this ground water sample. Please state your answer clearly for full credits. (15%)

5. The transformation of 1, 1, 1-trichloroethane by the mineral iron sulfide has been shown to be a second-order reaction, depending on the concentration of 1, 1, 1-trichloroethane remaining (unit in M) and the surface-area concentration of FeS (unit in m^2/L). The transformation of 1, 1, 1-trichloroethane by anaerobic bacteria is also found to be second-order, depending on the concentration of 1, 1, 1-trichloroethane remaining (unit in M) and the concentration of bacteria (mg/L). It is hypothesized that when FeS and bacteria are combined in one system, total removal can be described by parallel and independent second-order rate expressions.

   (a) Write the rate expression describing the total removal of 1, 1, 1-trichloroethane by the combination of FeS and bacteria. (10%)

   (b) Under what kind of condition (or assumption) so that your answer for part (a) can be converted into a pseudo-first-order expression such that removal is first-order with respect to 1, 1, 1-trichloroethane only. (10%)

6. Derive the integrated rate equation for an irreversible reaction of stoichiometry $2A + B \rightarrow Z$. the rate being proportional to $[A]^2[B]$ and the reactants present in stoichiometric proportions; take the initial concentration of A as $2a_0$ and that of B as a_0. Obtain an expression for the half-life of the reaction. (20%)