

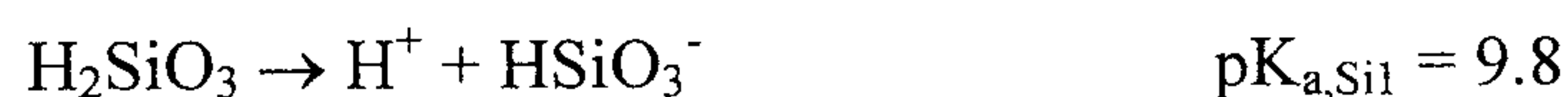
國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系乙組（化學組）

考試科目（代碼）：環境化學（2302）

共 3 頁，第 1 頁 *請在【答案卷、卡】作答

1. Please define or explain the following terms. (25%, 5% for each)
 - (A) Greenhouse gases and their global warming potentials.
 - (B) Sources of hydroxyl radicals in the atmosphere.
 - (C) Resources and type of renewable energy.
 - (D) Penetration of water and metal ions adsorption over time in sandy loam and clay loam.
 - (E) Definition and species of photochemical oxidants.
2. Please answer the following questions (22%)
 - (A) The pH value of a eutrophicated lake (2%)
 - (B) The CO₂ concentration in the atmosphere (2%)
 - (C) The concentration of hydroxyl radicals in the atmosphere (2%)
 - (D) The oxygen demand and total organic carbon of 10 mg/L glucose (4%)
 - (E) The buffer capacity of 10 mM acetic acid at pH 5 (pK_a = 4.7) (2%)
 - (F) The coordination number of nitrilotriacetic acid. (2%)
 - (G) The solar energy flux to the Earth surface. (2%)
 - (H) The ionic strength and pH of 10 mM NaHCO₃ and 10 mM Na₂CO₃ in solutions (pK_{a1} = 6.3; pK_{a2} = 10.3). (4%)
 - (I) The dissolved oxygen concentration in water at 25 °C. (2%)
3. A river water has a carbonate alkalinity of 20 mg-CaCO₃/L and silicate alkalinity of 10 mg-SiO₂/L at pH 9.65. Please calculate the fraction of the total alkalinity contributed from the carbonate system. (10%)



國立清華大學 104 學年度碩士班考試入學試題

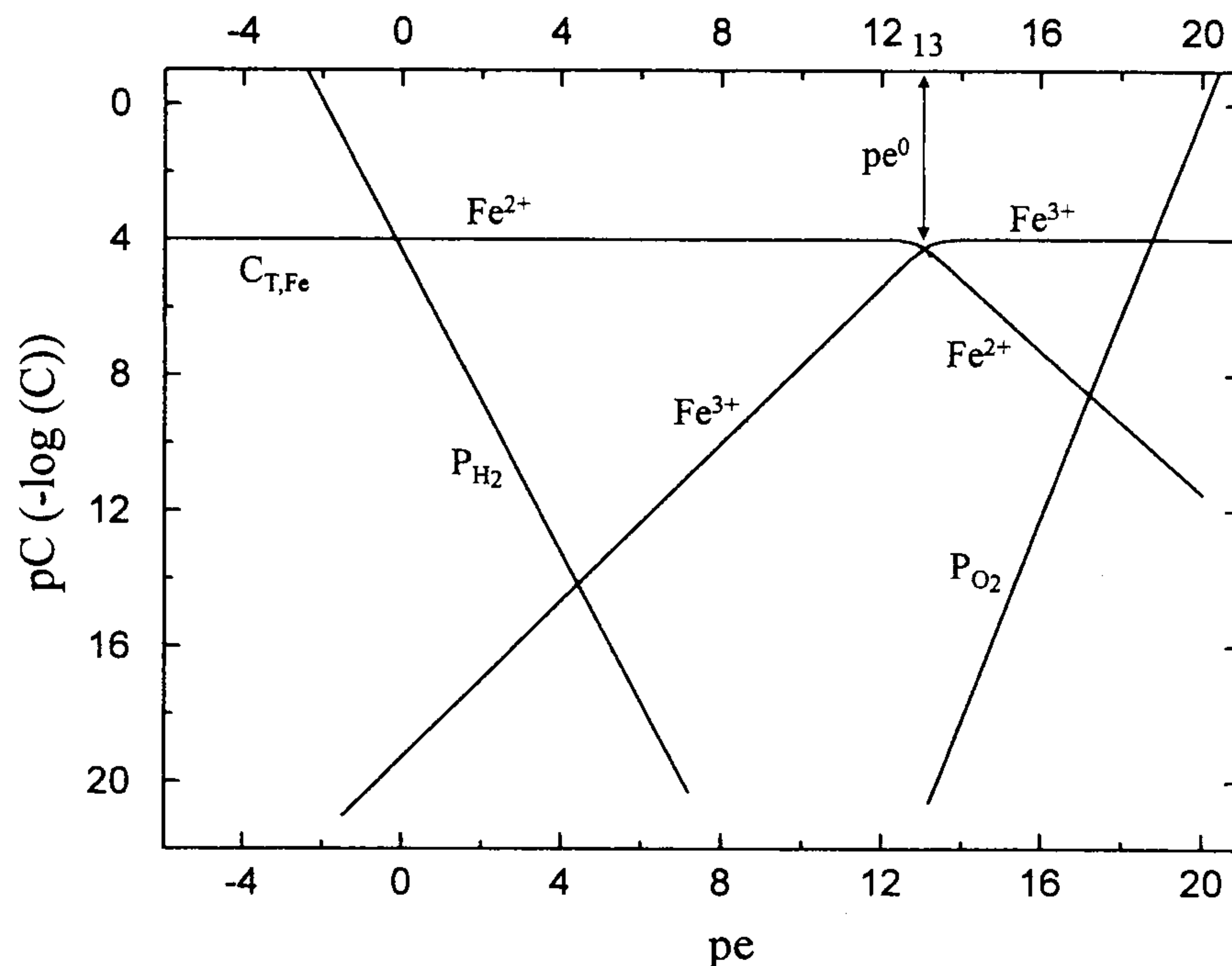
系所班組別：生醫工程與環境科學系乙組（化學組）

考試科目（代碼）：環境化學（2302）

共 3 頁，第 2 頁 *請在【答案卷、卡】作答

4. The following figure is the pC-pe diagram for a $\text{Fe}^{2+}/\text{Fe}^{3+}$ system at pH 2 and at 25 °C. Please answer the following questions:

- (A) What are the predicted equilibrium concentrations of Fe^{2+} and Fe^{3+} under oxic and H_2 -reducing conditions for a solution containing 10^{-4} M total iron? (5%)
- (B) What are the concentrations of Fe^{2+} and Fe^{3+} when pH changes to 5? (5%)
- (C) What partial pressure of oxygen would be in equilibrium at pH 2 when the ratio of Fe^{2+} and Fe^{3+} is 1,000? (5%)



5. The concentration of NO in the atmosphere is mainly produced from the reaction of N_2 with O_2 at high temperature. Now the standard Gibbs free energy (ΔG°) and enthalpy (ΔH°) of $\text{NO}_{(g)}$ at 25 °C are 86.7 and 90.4 kJ/mol, respectively. Please calculate the equilibrium NO concentration at a temperature of 2000 K. (10%)

國立清華大學 104 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系乙組（化學組）

考試科目（代碼）：環境化學（2302）

共 3 頁，第 3 頁 *請在【答案卷、卡】作答

6. Explain why the stratosphere is more susceptible to chemical pollution than the troposphere. (8%)
7. Soil is the unconsolidated and thin variable layer of mineral and organic materials. Aluminum (Al), iron (Fe) and silicon (Si) are the most abundant metal ions and humic substance is the typical organic compounds in soils. Please answer the following questions:
- (A) Why does Al become a dominant exchangeable cation in acid soil but not a dominant species in neutral soils? (4%)
- (B) According to the solubility in acid and base, humic substance can be divided into three groups, i.e. humin, humic acid and fulvic acid. Why fulvic acid is the predominant group of humic substance in natural system and the removal capacity toward metal ions adsorption is higher than that of humic acid. (6%)

Note: The atomic masses of elements are as follows:

H = 1.0	C = 12.0	N = 14.0	O = 16.0	Ca = 40.0	Na = 23.0
Mg = 24.3	Al = 27.0	Si = 28.1	S = 32.1	Cl = 35.5	K = 39.1
Fe = 56.0					