

注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。

國立清華大學 108 學年度碩士班考試入學試題

系所班組別：分析與環境科學研究所

考試科目(代碼)：環境化學(2902)

—作答注意事項—

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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共 2 頁，第 1 頁

*請在【答案卷】作答

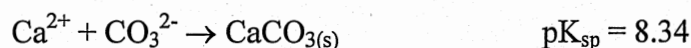
(1) Please define or explain the following terms: (20%, 5% for each)

- (a) Electron activity
- (b) Galvanic cell
- (c) Reverse osmosis
- (d) Soil texture

(2) A water contains the following water parameters.

Parameter	Concentration/Value
pH	8.0
Total alkalinity	300 mg/L as CaCO ₃
Ca ²⁺	145 mg/L
Mg ²⁺	18.3 mg/L
SO ₄ ²⁻	192 mg/L
Cl ⁻	71 mg/L
NH ₃ -N	3.5 mg-N/L

- (a) Please calculate the concentrations of bicarbonate (HCO₃⁻) and carbonate (CO₃²⁻) ions in water. (10%)
- (b) Please determine the concentration of non-carbonate hardness. (8%)
- (c) Please use the Langelier index (LI = pH_a - pH_s, where pH_a is the actual pH in water, and pH_s is the theoretical pH value saturated with CaCO₃ in water) to determine the stability of water with CaCO₃? (7%)
- (d) Lime-soda process is used to remove hardness. Please determine the amounts of lime (calcium oxide) and soda required per liter. (10%)
- (e) Chlorination is used to remove NH₃-N and the product of ammonia oxidation is N₂. Please determine the final pH value after chlorination. (10%)



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共 2 頁，第 2 頁

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(3) Please define photochemical oxidants and show the possible reactions of the production of peroxyacetyl nitrate (PAN) in photochemical smog. (10%)

(4) The following table is the enthalpy of chemicals.

Chemical	Enthalpy (ΔH_f^0) (Kcal/mol)	Chemical	Enthalpy (ΔH_f^0) (Kcal/mol)
Octane	-59.71	CO _{2(g)}	-94.05
Methanol	-57.04	CO _{2(aq)}	-98.69
Methane	-17.89	H _{2O(g)}	-57.80
O _{2(aq)}	-3.9	H _{2O(l)}	-68.32

(a) Write out the balanced chemical equations for the complete combustion of octane and methanol. Which fuel generates more heat per mole of carbon dioxide produced? (7%)

(b) Gasohol (10% methane in gasoline) is regarded as an alternative fuel for automobiles. Which impact on greenhouse effect might you predict for engine emissions in a car running on gasohol instead of gasoline (Assume gasoline is essentially octane) ? (8%)

(5) Ozone in the stratosphere is formed when O₂ molecules absorb solar radiation.

(a) Please write down the formation mechanism of O₃ from O₂ in stratosphere. (5%)

(b) The maximum concentration of O₃ occurs at around 30 km altitude. Please determine the maximum ozone (O₃) concentration at the steady state by assuming the standard Gibbs free energy of O₃ is +163.4 kJ/mol at 25°C and 1 atm. (5%)

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					