

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 109 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

科目代碼：2902

考試科目：環境化學

—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。

國立清華大學 109 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)

共__2__頁，第__1__頁 *請在【答案卷】作答

- (1) Please explain and compare the following terms: (30%, 6% for each)
- (a) Stability Constant and Dissolution Constant
 - (b) Aerosol and PM_{2.5}
 - (c) Distribution Coefficient and Partition Coefficient
 - (d) Biotransformation and Biodegradation
 - (e) Primary Pollutants and Secondary Pollutants
- (2) Humic substances are widely found in natural environments such as soils and sediments.
- (a) Please describe the method to separate humic acid, fulvic acid, and humin in humic substances (7%)
 - (b) The empirical formula for humic acid is C₃₀₈H₃₃₅O₉₀N₅. Please calculate the percentage composition of C, H, N and O for humic acid. (8%)
 - (c) Fulvic acid has 45.1% oxygen. Compare this with the value for humic acid and state how this may indicate why fulvic acid is more effective on metal ion adsorption. (10%)
- (3) A river water has been sampled and shipped to the laboratory for analysis.
- (a) 100 mL of water sample is titrated with 0.02 N H₂SO₄. The titrant volume required to titrate to pH 8.3 is 20 mL, and then an additional 10 mL is required to pH 4.3. Please calculate the carbonate and total alkalinity of the river water (10%)
 - (b) Please calculate the pH value of the river. (5%)
 - (c) A wastewater containing 0.01 M H₂SO₄ is discharged to the river. What is the most wastewater volume that can be discharged per liter of river if the river pH may not drop to pH 6.3? (10%)



$$\text{pK}_{a1} = 6.3$$



$$\text{pK}_{a2} = 10.3$$

國立清華大學 109 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)

共 2 頁，第 2 頁 *請在【答案卷】作答

(4) Hydrogen gas is a clean energy which can be used to replace gasoline. Consider a vehicle powered by H_2 gas. Please answer the following questions:

(a) If the vehicle needs 3.1 kg of H_2 to have a 500 km range and the storage tank in the vehicle is 60 L. Please use the ideal gas law to calculate the tank pressure at 25 °C. (10%)

(b) Carbon nanotube is known to have a good capacity toward H_2 adsorption to reduce the tank pressure. Assume that carbon nanotube can adsorb 3 times higher than the weight of H_2 . What is the minimum amount of carbon nanotube needed to reduce the tank pressure to 20.0 atm. (10%)

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					