[redacted]

1. 環境科學科由下列科目組成：
生態學、微生物學、統計學、分析化學、有機化學、環境地質學、環境管理、物理化學

2. [redacted]

3. [redacted]

題號：1.

1. 解釋名詞：20%（每小題4分）

1-1. food pyramid

1-2. bioaccumulation

1-3. dynamic equilibrium of ecosystem

1-4. biomagnification

1-5. biocondensation factor (BCF)

題號：2

2-1. 請以生態學之觀點，闡釋碳、氮循環之全部流程，並敘述各種生物在上述循環之質能傳遞所扮演之角色。14%

2-2. 何謂"ecological succession"？在生態學上為何有這種現象？其最終目標是趨向何種生態体系？6%

三、何謂自營菌(autotroph)與異營菌(heterotroph)？請各舉一實例代表「自營菌」與異營菌，並指出其生長所需的碳源、能源及電源，以及可能的生化反應。(20%)

(背面仍有題目，請繼續作答)

四. 何謂指標生物(indicator organism)？試以河川調查為例，說明河川自「家庭污水污染」至「自淨」變化過程中，可能出現的各種微生物相，那些微生物(或生物)具有「指標生物」的特性，如何檢測？(20%)

五. 下表列出了某地大氣中臭氧(O_3)之觀測值($\mu g/l$)，試求出：

(1) 樣本之平均值及標準差？

(2) 母體平均值及標準差之95%信賴度下之双尾信賴區間？

樣本	1	2	3	4	5	6	7	8	9	10
濃度	2.51	1.69	3.62	1.14	3.26	1.63	1.97	2.71	1.20	1.21

六. 若考慮一個多項线性迴歸模型：

$$Y = a + b_1x_1 + b_2x_2 + \cdots + b_nx_n$$

試說明以最小二乘方法与最大概似法去推求 $a, b_1, b_2, \ldots, b_n$，在統計之基本含意上有何不同，何者可得較佳之結果？(或者兩者沒有差別？？)

七、

7-1 For the titration curve (pH vs. b) of a weak acid HA titrated with OH^-, derive the expression for pH as a function of pK_a, a, and b, where a = original mmol of HA, and b = mmol of OH^- added. Also, calculate the minimum value of the slope of this titration curve. (10%)

7-2 Given the following standard electrode potentials --

$MnO_4^- + 5e^- + 8H^+ \rightleftharpoons Mn^{2+} + 4H_2O$ $\quad E^0_{MnO4-} = +1.51$ V

$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$ $\quad E^0_{Fe3+} = +0.771$ V

Please calculate the equilibrium constant for the reaction

$MnO_4^- + 5Fe^{2+} + 8H^+ \rightleftharpoons Mn^{2+} + 5Fe^{3+} + 4H_2O$

(10%)

(背面仍有題目,請繼續作答)

八、Explain the following terms, and give an example for each of them. (20%)

8a Autoprotolysis

8b Common-ion effect

8c Coefficient of variation

8d Gross error

8e Galvanic cells

8f Mohr method

8g Please list a primary standard for bases (2%)

9. 請依照生成率之高低順序(由大而小)寫出下列各反應之可能產物. (每小題四分).

A. $HCHO + OH\cdot \rightarrow$

B. $CH_3CHO + OH\cdot \rightarrow$

C. $CH_3(CH_2)_2CH_3 + OH\cdot \rightarrow$

D. $C_3H_6 + OH\cdot \rightarrow$

E.  $+ OH\cdot \rightarrow$

10. A. CFC 為氯氟碳化合物之簡稱. 請寫出 F-12 與 F-113 之化學式 (四分)

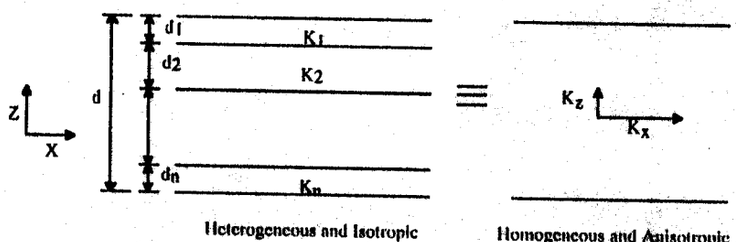
B. 請寫出苯乙烯、丁二烯與丙烯腈之化學式及其英文 IUPAC (12分)

C. 由B中之三種化合物所聚合之產物. 俗稱為 ABS, 請寫出其結構式 (四分)

11-1. Describe Darcy's law and appropriate flow conditions for the law. (4 分)

11-2. Explain isotropic and homogeneous aquifer formations. (4 分)

11-3. Consider the layered formation shown below (left). Each layer is homogeneous and isotropic with hydraulic conductivity, K_1, K_2, .., and K_n, and depth, d_1, d_2, .., and d_n. The system acts like a single homogeneous, anisotropic layer (shown right). Please use the parameters shown below (left) to express the equivalent vertical hydraulic conductivity, K_z, and horizontal hydraulic conductivity, K_x. (8 分)



Heterogeneous and Isotropic　　Homogeneous and Anisotropic

11-4. Adsorption is often found between aquifer materials and contaminants in groundwater systems. Define the term, adsorption, first, and then describe the importance of adsorption in groundwater systems. (4 分)

(背面仍有題目,請繼續作答)

12-1. What is the Dupuit-Forchheimer approximation (shallow flow approximation) for unconfined aquifers? (4 分)

12-2. Based on appropriate assumptions, derive from mass balance to show that the groundwater flow equation for unconfined aquifers under steady state is $\nabla^2 h^2 = 0$, where h is the hydraulic head. (10 分)

12-3. Show the procedures and mathematics about how you apply the equation in 12-2 to determine the hydraulic conductivity in a field site. (6 分)

十三. 目前机動車輛日益增多，為都會區主要的空氣污染源，試就(1)防污技術，(2)法規管理，(3)經濟誘因等三層面闡述如何改善都會區的空氣品質。

十四. 試述台灣水庫的主要問題為何？並分析其相關因素且列舉可能的改善措施。

15. Derive a reasonable rate equation (based on chain reaction mechanisms) for the gas-phase reaction $H_2 + Br_2 == HBr$. Experimentally, the rate can be well represented by the expression: $r_{HBr} = k[H_2]^{0.93}[Br_2]^{0.46}$. Explain it if there is a difference from your derived rate equation.

16. Assume that a refrigerator cools to 270 K, discharges heat at 300 K, and operates with 49% efficiency. (a) How much work would be required to freeze 1 kg of water ($\Delta_f H$ = -6.0 kJ/mol)? (b) How much heat would be discharged during the process?