

**應考說明：**

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

每科各出二題，每題二十分，由考生選答五題。

2. 考生選答題目請務必在作答試卷第一行先行註記題號。

例：作答題號(一)(六)(九)(十三)(十五)。

3. 作答超出五題或未註記題號者以作答次序前五題計分，超出部分不計分。

題號：一。(20分)

請闡釋污染物在生態系統中如何傳輸及其對生物之影響。舉一例說明。

題號：二。(20分)

請敘述生態系統中能量之轉運及傳送流程，並說明各種生物所扮演之角色。以碳、氮為例。

(背面仍有題目，請繼續作答)

20% 三. (1) 繪圖說明細菌的典型生長曲線 (批分式培養 Batch culture) 的各期意義。

(2) 若細菌接種培養初期, 生長十分緩慢, 可能原因為何?

(3) 何謂 diauxic growth?

(4) 以 *E. coli* 為例, 請設計一實驗, 可求得 *E. coli* 在乳糖 (lactose) 為唯一碳源的動力學常數 ( $K_s$ ) 值。

20% 四. (1) 舉例說明常見的水媒病原菌 (waterborne pathogens) 有那些?

(2) 請設計一實驗, 以偵測水源中可能有水媒病原菌的存在。

(3) 自選一種細菌為代表, 說明該細菌的培養與計數方法。

5. 有下列一組河川水質採樣之樣本分析數據, 其  $BOD_5$  ( $mg/l$ ) 記錄如下:

序號	1	2	3	4	5	6	7	8	9	10
濃度	15	25	40	35	51	26	29	47	30	11

試推求其平均值及標準差? (20%)

6. 試說明統計迴歸理論所採用之最小二乘方原理?  
並說明其優勢? (20%)

(背面仍有題目, 請繼續作答)

分析化學

七、 Calculate the molar solubility of  $\text{CaF}_2$  in (a) water, (b) 0.010 M  $\text{CaCl}_2$ , (c) 0.010 M  $\text{NaF}$  solution, given the  $K_{sp}$  as  $4.0 \times 10^{-11}$  and neglecting hydrolysis of the fluoride ion. (20%)

八、 50.0 ml of 0.100 M sodium chloride solution is titrated with 0.100 M  $\text{AgNO}_3$ .

Calculate pCl at the following points:

- Start of titration
- After addition of 49.9 ml  $\text{AgNO}_3$
- Equivalence point
- After addition of 60.0 ml of  $\text{AgNO}_3$

(Note:  $K_{sp}$  of  $\text{AgCl} = 1.0 \times 10^{-10}$ ,  $\text{pCl} = -\log [\text{Cl}]$ ) (20%)

有機化學

- 九、9-1. When HBr is reacted with 1,3-butadiene, an 1,4-addition product is found in addition to the 1,2-addition product. (a) What is 1,4-addition? (b) Write a detailed mechanism and explain how this 1,4-addition occurs. (10%)
- 9-2. Phenol is more acidic than alcohols because it reacts with NaOH to form sodium phenoxide, while alcohols won't react with NaOH. Please explain why phenol is acidic. (5%)
- 9-3. When 1-pentyne is reacted with aqueous sulfuric acid in the presence of mercuric sulfate catalyst, a ketone is obtained. Please explain the mechanism of this reaction. (5%)
- 十、10-1. Synthesize p-chlorobenzoic acid starting from benzene. (5%)
- 10-2. Draw the structure of (*S*)-2-pentanol that shows its stereochemistry (4%)
- 10-3. What is an  $S_N2$  reaction? Give an example. (7%)
- 10-4. What is the chemical nature of ethoxide anion,  $C_2H_5O^-$ ? In other words, what kind of reagent can it be? (4%)

(背面仍有題目,請繼續作答)

11. Hydraulic testing methods are often used to determine several hydrogeological parameters. The methods commonly used in interpreting the field data include Thiem and Theis equations, recovery method, and slug test. Please answer the following questions related to the testing methods.
  - 11-1. Determine the methods can be used under steady-state condition and the ones can be used under transient condition. (5分)
  - 11-2. Show the aquifer conditions (confined or unconfined) that each method can be applied to. (5分)
  - 11-3. Show the parameters that can be obtained through each method. (5分)
  - 11-4. What is the minimum number of wells required for each method? (5分)
  
- 12-1. Define the principal types of vibration of earthquakes, and describe the waves that move fastest and slowest. (5分)
- 12-2. Land subsidence can be subdivided into several types based on their causes. Describe the major mechanisms to induce land subsidence. (5分)
- 12-3. Explain "greenhouse effect" and "ozone depletion", and the reasons to cause the problems. (5分)
- 12-4. Sanitary landfill is one of the important method to treat urban solid waste. What are the important engineering practices that need to be done to minimize the environmental pollution caused by landfill method? (5分)

13. 試述「永續發展」(sustainable development)的意義,

並以台灣地區水資源邁向永續發展的課題為例, 列舉可能改善的目標與策略。(20%)

14. 分析都會區的交通與噪音問題及其關鍵因素, 並簡述可能的改善策略。(20%)

(背面仍有題目, 請繼續作答)

15. One mole of an ideal gas ( $C_{v,m} = \frac{3}{2}R$ ) at  $25^\circ\text{C}$  is compressed adiabatically and reversibly from  $0.100\text{ m}^3$  to  $0.010\text{ m}^3$ . Calculate  $q$ ,  $w$ ,  $\Delta U$  and  $\Delta H$  for the process. (Gas constant  $R = 8.315\text{ J K}^{-1}\text{ mol}^{-1}$ ). (20%)

16. The partial molar volume  $\bar{V}_2$  of  $\text{K}_2\text{SO}_4$  in water solutions at  $298\text{ K}$  is given by

$$\bar{V}_2 (\text{cm}^3) = 32.280 + 18.216 m^{1/2} + 0.0222 m \quad (m = \text{molality})$$

Obtain an equation for  $\bar{V}_1$ , the partial molar volume of  $\text{H}_2\text{O}$ . Assume the molar volume of pure water is  $17.963\text{ cm}^3\text{ mol}^{-1}$ . (20%)