

I. 填充題 (不需寫計算過程；每個答案三分，共六十分)

- Round the answer with the correct number of digits: $100.000 - (2.000 \times 10^2) + (5.000 \times 10^3) = 4900.000$, Answer: (1)
- Round the answer with the correct number of digits: $\log(2.00 \times 10^4) = 4.301029996$. Answer: (2)
- Find the pooled standard deviation for two methods whose standard deviations and the numbers of measurements are $s_1 = 0.03$, $n = 7$ and $s_2 = 0.09$, $n = 3$. Answer: (3)
- Find the ionic strength for an aqueous solution containing 0.010 M ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) and $\text{PbS}(s)$. Answer: $\mu =$ (4) M (K_{sp} of PbS : 3×10^{-28})
- The amount of Cl^- in an unknown sample was gravimetrically analyzed by adding excess $\text{AgNO}_3(aq)$ ($\text{pH} \sim 1.0$). What is the dominant species in the *counter ion layer*? Answer: (5)
- For quantitative analysis, what method(s) is/are appropriate when the sample matrix is complex and difficult to reproduce in standard solution? Answer: (6)
- Considering the solubility case of lead(II), species such as PbI^+ and $\text{PbI}_2(aq)$ also contribute to the total solubility. Please list *all* the species in the saturated $\text{PbI}(s)$ solution: (7)
- In the above lead(II) iodide case, please write down an equation to express the solubility of $\text{PbI}_2(s)$ as a function of $[\text{I}^-]$. $[\text{Pb}]_{\text{total}} =$ (8) (Use either stepwise formation constants, K_b , or overall formation constants, β_i .)
- The concentration of one of the lead(II) species in the answers of Questions 7 and 8 is **independent** of $[\text{I}^-]$. What is it? Answer: (9)
- Write the mass balance equation for CaF_2 in an aqueous solution if the reactions involving F^- are $\text{CaF}_2(s) \rightleftharpoons \text{Ca}^{2+} + 2\text{F}^-$, $\text{F}^- + \text{H}^+ \rightleftharpoons \text{HF}(aq)$, and $\text{HF}(aq) + \text{F}^- \rightleftharpoons \text{HF}_2^-$. Answer: $[\text{Ca}^{2+}] =$ (10)
- Write down the Henderson-Hasselbalch equation for an acid, HA: (11)
(In your equation, what the terms stand for should be denoted.)
- For a 100-mL solution containing 1.00 g of imidazole (FM 68.08) and 1.00 g of imidazole hydrochloride (FM 104.54), the solution pH is 7.18. How many milliliters of 1.00-M HClO_4 should be added to the solution to yield a solution pH of 6.993? Answer: $V_{\text{HClO}_4} =$ (12) mL. (pK_a for imidazole: 6.993)
- A 100.0-mL solution of the ion M^{n+} at a concentration of 0.0500 M buffered to pH 10.00 was titrated with 0.1000 M EDTA. The concentration of M^{n+} at $V = \frac{1}{2}V_{\text{eq}}$ is (13) M.
(V_{eq} = equivalence point; $K_{\text{MY}} = 2.00 \times 10^{20}$; $\alpha_{Y^{4-}} = 0.3$ at pH 10.00)
- Which of the following light source(s) is/are commonly used in atomic absorption spectroscopy? Deuterium lamp, tungsten lamp, Nd:YAG laser, laminar-flow burner (flame), hollow-cathode lamps, ICP torch, and electrothermal graphite furnace. Answer: (14)
- Write down the equation for quantitative analysis utilizing fluorescence emission: (15) (In your equation, what the terms stand for should be denoted.)
- Chemical interference is common in atomic spectroscopy. Give an example of chemical interference and an approach to decrease the interference in your example. Answer: (16)
- A high-resolution mass spectrum can be obtained by a *double-focusing* mass spectrometer. What is/are the parameter(s) of ions narrowed by the "double-focusing" mass analyzer? Answer: (17)
- Write down the van Deemter equation: $H \approx$ (18) (What the terms stand for should be denoted.)
- There are a variety of modes of sample injection in GC. What is suitable for *thermally unstable* solutes? Answer: (19)
- In LC, what term is used to estimate the relative solvent adsorption energy and what is the descending order for the following 3 solvents (from the largest to the smallest)? pentane, 2-propanol, diethyl ether
Answer: (20)

II. 問答題 (每題十分，共四十分)

1. Describe the difference between $\mu \pm z\sigma$ and $\mu \pm \frac{ts}{\sqrt{n}}$.
2. Developed in 1883, the Kjeldahl nitrogen analysis remains one of the most prevailing methods for determining nitrogen in dairy products. The sample is *digested* and *boiled*. The vapor is *acidified* by a known amount of HCl. Please describe the purpose of *boiling* and briefly explain how the total nitrogen in the sample is determined.
3. List the step-by-step instruction for preparation of a pH 5.0 citrate (H_3A) buffer (1.00-L). The total concentration of citrate salts is 0.1 M. The pK_a s are 3.128, 4.761, and 6.396, respectively, for H_3A , H_2A^- , and HA^{2-} . (*Do NOT show calculation.*)
4. Draw the *line diagram* of the cell of a combination electrode which integrates both glass and reference electrode in one body. Explain how the potential across the glass membrane allow us to find the solution pH. Assume that the outer and inner reference electrodes are both Ag/AgCl(s).

