

科目：分析化學(1005)校系所組：中央大學化學學系交通大學應用化學系 (甲組)清華大學化學系清華大學材料科學工程學系 (丙組)

1. (30%)

You are given a 25 mL aqueous solution containing a mixture of Na^+ , Ca^{2+} , Ag^+ , and Al^{3+} ions with the concentration range ~ 1 mg/L. Describe five different techniques to determine the concentrations of the four ions. Give the correct name of the technique and briefly explain how the determination can be done.

2. (20%)

Many mass analyzers and ionization techniques in mass spectrometry have been developed in the past two decades. Indicate which mass analyzer and ionization technique are best suited for the following analysis, and give your reasoning.

- (a) Determination of the molecular weight ($\geq 100,000$) of a biological molecule.
 (b) Structure determination of organic compounds introduced to the mass spectrometer through gas chromatography.

3. (10%)

An aqueous solution contains AgNO_3 and electrolyte. The silver ion (Ag^+) is precipitated as AgSCN by addition of KSCN . Please explain the effects of AgNO_3 concentration and electrolyte concentration on the thickness of the double layer surrounding a colloidal particle (AgSCN) in a solution containing excess of AgNO_3 .

4. (20%)

Calculate the pH after addition of (a) 12.5 mL and (b) 25.0 mL of 0.100 M NaOH in the titration of 50.0 mL of 0.050 M benzoic acid. ($\text{C}_6\text{H}_5\text{COOH}$, $K_1 = 6.28 \times 10^{-5}$)

5. (20%)

- (a) Calculate the equilibrium constant (K_{eq}) for the following reaction.
 (b) Calculate the electrode potential of the reaction at the equivalence point.
- $$\text{Sn}^{2+} + 2\text{Fe}^{3+} = \text{Sn}^{4+} + 2\text{Fe}^{2+}$$

Half-Reaction	E°, V
$\text{Sn}^{2+} + 2\text{e}^- = \text{Sn(s)}$	-0.136
$\text{Sn}^{4+} + 2\text{e}^- = \text{Sn}^{2+}$	+0.154
$\text{Fe}^{2+} + 2\text{e}^- = \text{Fe(s)}$	-0.440
$\text{Fe}^{3+} + \text{e}^- = \text{Fe}^{2+}$	+0.771