※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

Inorganic Chemistry and Analytical Chemistry (total points: 100)

Part I: Inorganic Chemistry (total points: 50)

(1) Determine the possible microstates for an s^1p^1 configuration, and use them to prepare a microstate table. (10 pts)

(2) Determin the possible values of J (total angular momentum quantum number) for the carbon terms. (5 pts)

(3) Confirm that a (real) $2p_x$ orbital is orthogonal to a (real) $2p_y$ orbital of the same atom. (5 pts)

(4) Reduce the following representations to their irreducible representations in the point group indicated: (10 pts)

C_{2h}	E	C_2	i	σ_h
Γ	4	0	2	2

(5) Using the angular overlap model, determine the splitting pattern of d orbitals for a tetrahedral complex of formula $\mathbf{MX_4}$, where **X** is a ligand that can be act as σ donor and π donor. (10 pts)

(6) For which d^n configurations would no Jahn-Teller splitting expected for the tetrahedral case (ignore possible low-spin case) (10 pts)

(背面仍有題目,請繼續作答)

※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

Part II: Analytical Chemistry (Total points: 50)

(1) A spectrum has a signal-to-noise ratio of 8/1. How many spectra must be averaged to increase the signal-to-noise ratio to 20/1? (5 pts)

(2) A solution was prepared by mixing 10.00 mL of unknown (X) with 5.00 mL os standard (S) containing 8.24 μg S/mL and diluting the mixture to 50.0 mL. The measured signal quotient was (signal due to X/signal due to S) = 1.690/1.000.
   (a) In a separate experiment in which the concentrations of X and S were equal, the quotient was (signal due to X/signal due to S) = 0.930/1.000. What is the concentration of X in the unknown? (5 pts)
   (b) Answer the same question if, in a separate experiment in which the concentration of X was 3.42 times the concentration of S, the quotient was (signal due to X/signal due to S) = 0.930/1.000. (5 pts)

(3) State the advantages and disadvantages of a furnace compared a flame in atomic absorption spectroscopy. (5 pts)

(4) Two solutes have a separation factor of $\gamma = 1.06$. How many plates are required to give a resolution of 1.0? of 2.0? If the plate height is 0.20 mm, how long must the column be for a resolution of 1.0? (5 pts)

(5) The cell SCE‖I^- (x M), PbI_2 (s) | Pb
   (a) Develop an equation that relates the potential of the cell to pI. (5 pts)
   (b) Calculate pI if the cell has a potential of –0.348 V (5 pts)
   $K_{sp} = [Pb^{2+}][I^-]^2 = 7.9\times10^{-9}$
   $E^0_{Pb2+/Pb} = -0.126$ V
   $E_{SCE} = 0.244$ V

(6) A mixture of 14 compounds was subjected to a reversed-phase gradient separation going from 5% to 100% acetonitrile with a gradient time of 60 min. The sample was injected at t = dwell time. All peaks were eluted between 22 and 41 min.
   (a) Is the mixture more suitable for isocratic or gradient elution? (5 pts)
   (b) If the next run is a gradient, select the starting and ending % acetonitrile and the gradient time. (10 pts)