1. (15 points) The following components are available for flame atomic spectroscopy experiments
   Flame (nebulizer/burner system), F
   Hollow-cathode lamp (high intensity), HCL
   Monochromator with photomultiplier tube attachment, M/PMT
   AC signal processing and readout system, SP
   Draw block diagrams of the setups you would put together for 1) flame atomic emission, 2) flame atomic absorption, and 3) flame atomic fluorescence.

2. (8 points) Please define effective bandpass and slit width. How does slit width influence bandpass and light throughput?

3. (6 points) Please state the possible causes of the deviation of Beer's law.

4. (8 points) In molecular fluorescence measurement, the excitation and emission spectra usually bear an approximate mirror image relationship to one another. Please state the reason and how these two spectra are measured.

5. (4 points) Calculate the resolution required to resolve peaks from mass spectra for
   (a) CH_2N^+ (MW = 28.0187) and N_2^+ (MW = 28.0061)
   (b) $^{116}Sn^+$ (AtW = 115.90219) and $^{232}Th^{2+}$ (AtW = 232.03800)

6. (9 points) The relationship between plate height and column variables can be approximated by van Deemter equation
   $H = A + B/u + Cu$
   where H is the plate height; u is the linear velocity of the mobile phase; A, B, and C are coefficients of multiple pathlength, longitudinal diffusion, and mass transfer, respectively. Please plot H *versus* u figure to describe the contribution of each term to H and the overall variation of H with respect to u.

(背面仍有題目,請繼續作答)

7. (5 points) Compare wavelength dispersive instrument and energy dispersive instrument of X-ray fluorescence.

8. (5 points) How can one distinguish between ESCA peaks and Auger peaks?

9. (5 points) A chemist analyzed the alcohol content of three replicates of a blood sample. The results are : 0.084%, 0.089%, and 0.079%. Calculate the 95% confodence limit (t=4.30) for the mean.

10. (5 points) Explain how a gas-sensing probes can be used to determine gas dissolved in water.

11. (10 points) The controlled-cathode-potential method is a potent tool for separating and determining metallic species having standard potentials that differ by only a few tenths of a volt. Describe a controlled-potential apparatus and explain how the potential of the working electorde can be controlled.

12. (5 points) Compare volumetric titration and weight titration in term of precision.

13. (5 points) Discuss the influence of the concentration of a titrant on the precision of the results. (5)

14. (10 points) Calculate the solubility of $BaCO_3$ in water.
($K_{sp}=5.0 \times 10^{-9}$ for $BaCO_3$; $K_{a1}=4.45 \times 10^{-7}$, $K_{a2}=4.69 \times 10^{-11}$ for carbonic acid; $K_w=1.00 \times 10^{-14}$)