1. A 25 ml class A volumetric pipet delivers 25.00 ± 0.03 ml. If you deliver 100 ml with 4 aliquots of 25 ml, what is the uncertainty in the total volume delivered? Please explain your calculation. **(5%)**

2. Describe the procedure of comparing two means(平均值). **(8%)**

3. (a)Why is the buffer capacity maximum when pH = pKa? **(4%)**
   (b). Describe the procedure of preparing a 1.00 liter of 100 mM phosphate buffer solution, pH 7.60. (phosphoric acid, $pK_{a1} = 2.15$, $pK_{a2} = 7.20$, $pK_{a3} = 12.15$, atomic weight, P = 31, O = 16, H = 1) **(6%)**

4. Why is it not practical to titrate an acid or base that is too weak or too dilute? **(5%)**

5. An aqueous glycerol solution weighting 100.0 mg was treated with 50.0 ml of 0.0837 M Ce^{4+} in 4 M $HClO_4$ at 60 ℃ for 15 min to oxidize the glycerol to formic acid. The excess Ce^{4+} required 12.11 ml of 0.0448 M Fe^{2+} to reach a ferroin end point. What is the weight percent of glycerol in the unknown? **(6%)**

6. In mass spectrometry, (a). What is the selected reaction monitoring? (b). What are the advantages of selected reaction monitoring? **(8%)**

7. Why is the development of Fourier transform NMR important for carbon-13 (^{13}C)NMR? **(4%)**

8. Describe the advantage of atomic force microscope over scanning tunneling microscope. **(4%)**

9. 填充題（請將答案填寫於答案本上）**(total 30%; 3% each)**

A If the difference between the potentials at which the peak anodic and peak cathodic currents are observed is 28.5 mV, the number of electrons in the half reaction is ____(A)____.

B Of the following compounds, ____(B)____ can be used to reduce $HAuCl_4$ to form gold nanoparticles: ascorbic acid, bromate, hydrogen peroxide, and iodate.

C If the ratio of the emission rate of a fluorophore at the concentration of 100 nM to its absorption rate is 0.5, the quantum yield of the fluorophore is ____(C)____.

D Of the following equations, ____(D)____ is commonly used to determine the formation constant for the complex between an enzyme and its substrate: Scatchard

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equation; Gran plot equation; and van Deemter equation.

E If the lowest excited state of an unknown atom lies 3.591×10^{-19} J/atom above the ground state and the degeneracy values of the excited and ground states are 2 and 1, respectively, the fraction of sodium atoms in the excited state at 2600 K is __(E)__.

F If the retention times for A (unretained compound) and benzene are 42 s and 252 s in gas chromatography, the capacity for benzene is __(F)__.

G If the capillary length and effective length are 40 and 30 cm, respectively, the migration time for a neutral compound is 2 min at an applied voltage of 30000 V, the electroosmotic flow mobility is __(G)__.

H Using C18 on 5 μm silica column as a stationary phase and acetonitrile as a mobile phase, the elution order for the following compounds in high performance liquid chromatography is __(H)__: benzyl alcohol; ethyl benzoate; and methanol.

I Of the following techniques, __(I)__ is most powerful for DNA sequencing: capillary zone electrophoresis; capillary gel electrophoresis; and micellar electrokinetic chromatography.

J Of the following detection modes, __(J)__ is the best for detecting dextran (polymers of sugar glucose): UV-Vis absorption; fluorescence; and light scattering.

10. Schematic designs of **(total 15%; 5% each):**

(A) A cell used to measure the standard potential of the reaction between Ag^+ and Cd(s).

(B) Atomic absorption spectrophotometer.

(C) Fluorometer.

11. If the cell potential is 0.331 V (vs. standard hydrogen electrode) in a buffer (pH 9.0) containing 0.5 and 2.0 mM M^{2+} and EDTA, what is the formation constant of $M(EDTA)^{2-}$? (E^0 for $M^{2+} = 0.852$ V, $\alpha_{Y4-} = 0.36$) **(5%)**

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