無機與分析化學（分析部分） (50%)

Answer the following questions

Note :

(a) Must show detailed calculation processes in your answer.

(b) The calculation results might be ignored if calculator is prohibited.

1. Species of arsenic found in drinking water include AsO_3^{3-} (arsenite), AsO_4^{3-} (arsenate), $(CH_3)_2AsO_2^-$ (dimethylarsinate), and $(CH_3)AsO_3^{2-}$ (methylarsonate). Pure water containing no arsenic was spiked with 0.40 μg arsenate/L. Seven replicate determinations gave 0.39, 0.40, 0.38, 0.41, 0.36, 0.35, and 0.39 μg/L. Find the mean percent recovery of the spike and the concentration detection limit (μg/L). (10%, each 5%)

2. (a) Calculate the activity coefficient of H^+ with the ion size $\alpha = 900$ pm when $\mu = 0.025$ M.

   (b) Find the concentration of Ca^{2+} in equilibrium with 0.050 M NaF saturated with CaF_2. The solubility of CaF_2 is small, so the concentration of F^- is 0.050 M from NaF. The activity coefficients of Ca^{2+} and F^- when $\mu = 0.0500$ M are 0.485 and 0.81, respectively. K_{sp} for CaF_2 is 3.2×10^{-11}. (10%, each 5%)

3. By how many volts will the potential of an ideal Ca^{2+} ion selective electrode change if the electrode is removed from 1.00×10^{-4} M $CaCl_2$ and placed in 1.00×10^{-3} M $CaCl_2$ at 25°C? (5%)

4. The molar absorptivities of compounds X and Y were measured with pure samples of each:

	ε (M^{-1} cm^{-1})	
λ (nm)	X	Y
272	16400	3870
327	3990	6420

A mixture of compounds X and Y in a 1.00 cm cell had an absorbance of 0.700 at 272 nm and 0.550 at 327 nm. Find the concentrations of X and Y in the mixture. (10%, each 5%)

5. A peak with a retention time of 407 s has a width at half height of 7.6 s. A neighboring peak is eluted 17 s later with $w_{1/2}$ = 9.4 s. Find the resolution for these two components. (5%)

6. The voltage applied to the 0.84-m-long capillary is 2.50×10^4 V. A neutral marker molecule, carried by electroosmotic flow, requires 308 s to travel 0.640 m from the inlet to the detector. Migration time of P^{n-} is 343 s. (a) Find the electroosmotic velocity and electroosmotic mobility. (b) Find the apparent and electrophoretic mobilities of P^{n-}. (10%, each 2.5%)

（無機部分） (50%)

1. Construct the molecular orbital of C_2^{2-} and write down its electronic configuration, magnetic property and bond order. (10%)

2. Why is the ionization energy of B less than Be and O less than N. (5%)

3. Nitrogen-nitrogen triple bond is very strong; however it can be activated by organometallic compounds. Give the reasons. (5%)

4. Calculate the spin-only magnetic moment for the following free ions (a) Fe^{3+} (b) Cr^{3+} (c) Ti^{3+} (6%)

5. Draw all the possible isomers of $[Co(NH_3)_2(H_2O)_2BrCl]^+$ (5%)

6. Describe the effect of Jahn-Teller Distortion on d orbitals of an octahedral complex. Consider both elongation and compression on the z axis. (9%)

7. Comparing the following two reactions, which will have faster reaction rate? Why? (10%)