ANALYTICAL CHEMISTRY

1. The Ca content of a mineral sample was analyzed five times by each of two methods, with similar standard deviations:

   <u>Ca content</u>

   | method 1: | 0.271 | 0.282 | 0.279 | 0.271 | 0.275 | (10%) |
   | method 2: | 0.271 | 0.268 | 0.263 | 0.274 | 0.269 | |

   Are the mean values significantly different at the 90% confidence level? (Student's t value for 8 degree of freedom at 90% confidence level = 1.86)

2. Using activities, find the concentration of Ba^{2+} in a 0.033 M $Mg(IO_3)_2$ solution saturated with $Ba(IO_3)_2$. (K_{sp} of $Ba(IO_3)_2$ = 1.57×10^{-9}; activity coefficients of Ba^{2+} = 0.38, IO_3^- = 0.78)　　　　　　　　(10%)

3. Write the titration reaction and the end-point reaction in (a) Mohr titration and (b) Volhard titration.　　　　　　　(16%)

4. A CN^- solution with a volume of 12.73 ml was treated with 25.00 ml of Ni^{2+} solution (containing excess Ni^{2+}) to convert the CN^- into $Ni(CN)_4^{2-}$. The excess Ni^{2+} was then titrated with 10.15 ml of 0.01307 M EDTA. $Ni(CN)_4^{2-}$ does not react with EDTA. If 39.35 ml of EDTA was required to react with 30.10 ml of the original Ni^{2+} solution, calculate the molarity of CN^- in the 12.73-ml sample.　　　　　　　(10%)

5. What is the pH at the equivalence point when 20 ml 0.030 M NaF is titrated with 0.060 M $HClO_4$? (K_b of F^- = 1.5×10^{-11})　　　　(10%)

6. From the half-reactions below, calculate the solubility product of $Mg(OH)_2$.

   $$Mg^{2+} + 2e^- \rightleftharpoons Mg_{(s)} \qquad\qquad E^\circ = -2.36\ V$$
   $$Mg(OH)_{2(s)} + 2e^- \rightleftharpoons Mg_{(s)} + 2OH^- \quad E^\circ = -2.69\ V \qquad (10\%)$$

7. H_2S in aqueous solution can be analyzed by titration with coulometrically generated I_2:

   $$H_2S + I_2 \rightarrow S_{(s)} + 2H^+ + 2I^-$$

   To 50.0 ml of sample was added 4 g of KI. Electrolysis required 812 s at a constant current of 52.6 mA. Calculate the concentration of H_2S ($\mu g/ml$) in the sample. (M.W. of H_2S=34.1; KI=166.0)　　　　　(10%)

8. (A) List the approximate wavelength range (in nm) of (a) ultraviolet (UV) spectrum; (b) visible spectrum; (c) mid-infrared (IR) spectrum. (B) Give an example of the light source for each of the wavelength region in (A).　(12%)

9. A solution containing 6.3×10^{-8} M I^- and 2.0×10^{-7} M p-dichlorobenzene gave GC peak areas of 395 and 787, respectively. (a) Find the response factor for I^- with respect to the internal standard, p-dichlorobenzene. (b) A 3.00-ml solution of unknown containing I^- was treated with 0.100 ml of 1.6×10^{-5} M p-dichlorobenzene and the mixture was diluted to 10.00 ml. GC gave peak areas of 633 and 520 for I^- and p-dichlorobenzene, respectively. Find the concentration of I^- in the 3.00 ml of original unknown.　　　(12%)