

1. Calculate the following results: 15 pts

(a)  $[4.97(\pm 0.05) - 1.86(\pm 0.01)] / 21.1(\pm 0.2)$

(b)  $[3.14(\pm 0.05)]^{1/3}$

(c)  $\log [3.14(\pm 0.05)]$

2. (a) A chromatography column with a length of 10.3 cm and inner diameter of 4.61 mm is packed with a stationary phase that occupies 70.0% of the volume. If the volume flow rate is 1.13 mL/min, find the linear flow rate in cm/min.

(b) How long does it take for solvent which is the same as unretained solute to pass through the column?

(c) Find the retention time for a solute with a capacity factor of 10.0. 15pts

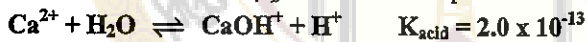
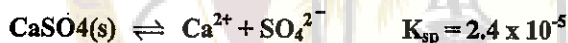
3. A solution containing 3.47 mM X (analyte) and 1.72 mM S (standard) gave peak areas of 3473 and 10222, respectively, in a chromatographic analysis. Then 1.00 mL of 8.47 mM S was added to 5.00 mL of unknown X, and the mixture was diluted to 10.0 mL. This solution gave peak areas of 5428 and 4431 for X and S, respectively. 15 pts

(a) Calculate the response factor for the analyte.

(b) Find the concentration of S (mM) in the 10.0 mL of mixed solution.

(c) Find the concentration of X in the original unknown.

4. Given the following equations : 20pts



(a) Write mass balance for Ca species and charge balance.

(b) Estimate the concentration of  $[\text{Ca}^{2+}]$ ,  $[\text{SO}_4^{2-}]$ ,  $[\text{CaOH}^+]$ , and  $[\text{HSO}_4^-]$  if  $\gamma_{\text{Ca}^{2+}} = 0.570$  and  $\gamma_{\text{SO}_4^{2-}} = 0.542$  are considered, but the remaining activity coefficients are assumed to be 1.

5. According to Beer's law, given  $b = 1\text{cm}$ ,  $\epsilon = 10000 \text{ M}^{-1}\text{cm}^{-1}$  for a substance

measured at  $\lambda = 600\text{nm}$ , and the acquired  $T = 0.20 \pm 0.02$ , estimate the concentration of the substance including the uncertainty. 15pts

6. The dissociation of the complex between thorium and quercetin can be expressed as  $\text{ThQ}_2 \rightleftharpoons \text{Th} + 2\text{Q}$  (omitting formal charges). For a solution that was  $2.30 \times 10^{-5} \text{ M}$  in thorium and contained a large excess of quercetin, sufficient to ensure that all of the thorium is present as the complex, the absorbance was 0.780. When the same amount of thorium is mixed with a stoichiometric amount of quercetin, the absorbance was 0.520.

Calculate (a) the degree of dissociation and (b) the value of the formation constant of the complex. 20pts