Chem 201—Quantitative Analysis
Exam #2
12 November 2009

Name _____

1. (5 points) For the technique of flame atomic absorption spectrometry, increasing the temperature of the flame will:

   A. increase signal; improve detection limits

   B. increase signal; worsen detection limits

   C. decrease signal; improve detection limits

   D. decrease signal; worsen detection limits

   E. have no effect on signal or detection limits

2. (5 points) For the technique of flame emission spectrometry, increasing the temperature of the flame will:

   A. increase signal; improve detection limits

   B. increase signal; worsen detection limits

   C. decrease signal; improve detection limits

   D. decrease signal; worsen detection limits

   E. have no effect on signal or detection limits

3. (5 points) A buffer solution is made by mixing 0.135 M acetic acid with 0.207 M sodium acetate. The acid constant for acetic acid is $K_a = 1.75 \times 10^{-5}$. The pH of the resulting buffer solution is:

   A. pH = 4.57

   B. pH = 4.33

   C. pH = 5.18

   D. pH = 4.94

4. (5 points) The role of an auxiliary complexing ligand, L, when performing an EDTA titration is to:

   A. bind the metal ion as a complex ion in solution to prevent precipitation as a metal hydroxide.

   B. bind the metal ion as a precipitate, $ML_n(s)$, to prevent interference by hydroxide ion.

   C. improve the sharpness of the EDTA titration curve endpoint.

   D. act as an indicator for the titration.

5. (30 points) A mixture of X and Y was analyzed using UV/vis absorption spectroscopy at four different wavelengths to determine the concentrations of the two unknowns. The pathlength of the cell was 1.00 cm. The following data were obtained:

$A_{tot}(327\ nm) = 0.1304$	$\varepsilon_X(327\ nm) = 517\ M^{-1}cm^{-1}$	$\varepsilon_Y(327\ nm) = 279\ M^{-1}cm^{-1}$
$A_{tot}(403\ nm) = 0.0695$	$\varepsilon_X(403\ nm) = 85.0\ M^{-1}cm^{-1}$	$\varepsilon_Y(403\ nm) = 738\ M^{-1}cm^{-1}$
$A_{tot}(478\ nm) = 0.1386$	$\varepsilon_X(478\ nm) = 246\ M^{-1}cm^{-1}$	$\varepsilon_Y(478\ nm) = 1236\ M^{-1}cm^{-1}$
$A_{tot}(551\ nm) = 0.2289$	$\varepsilon_X(551\ nm) = 928\ M^{-1}cm^{-1}$	$\varepsilon_Y(551\ nm) = 426\ M^{-1}cm^{-1}$

Determine the concentrations of [X] and [Y].

6. (25 points) 50.00 mL of 0.150 M carbonic acid, H_2CO_3, is titrated with 0.250 M NaOH. Determine the pH at the first and second endpoints of the titration.

$H_2CO_3(aq) + H_2O \leftrightarrow HCO_3^-(aq) + H_3O^+(aq)$ $\quad K_{a1} = 4.46 \times 10^{-7}$

$HCO_3^-(aq) + H_2O \leftrightarrow CO_3^{2-}(aq) + H_3O^+(aq)$ $\quad K_{a2} = 4.69 \times 10^{-11}$

7. (25 points) 50.0 mL of a 0.00200 M Cd^{2+} solution is titrated with 0.00400 M EDTA in the presence of 0.0750 M NH_3 buffered at pH = 9.00. Determine pCd^{2+} when 28.5 mL of EDTA solution have been added.

$Cd^{2+} + Y^{4-} \leftrightarrow CdY^{2-}$ $\quad K_f = 3.16 \times 10^{16}$

$Cd^{2+} + NH_3 \leftrightarrow CdNH_3^{2+}$ $\quad \beta_1 = 3.24 \times 10^{2}$

$Cd^{2+} + 2\ NH_3 \leftrightarrow Cd(NH_3)_2^{2+}$ $\quad \beta_2 = 2.95 \times 10^{4}$

$Cd^{2+} + 3\ NH_3 \leftrightarrow Cd(NH_3)_3^{2+}$ $\quad \beta_3 = 5.89 \times 10^{5}$

$Cd^{2+} + 4\ NH_3 \leftrightarrow Cd(NH_3)_4^{2+}$ $\quad \beta_4 = 3.63 \times 10^{6}$

$\alpha_{Cd2+} = 1.80 \times 10^{-3}$

$\alpha_{Y4-} = 0.041$