Answer all questions. Be careful to give your final answer to the correct sig. figs.

1.   a)   *(3 points)* The acetate ion (CH_3COO^-) is a weak base. Write down the base-ionization equation for CH_3COO^- in water.

     b)   *(2 points)* Complete the expression for the base-ionization constant (K_b) for CH_3COO^-.

     c)   *(5 points)* Calculate the pH of a 0.40 M solution of CH_3COO^- (K_a for $CH_3COOH = 1.8 \times 10^{-5}$).

2.   a)   *(3 points)* Calculate the pH when 100 mL of 0.100 M $Ca(OH)_2$ solution is added to 50 mL of 0.400 M HCl solution.

     b)   *(2 points)*   Which one of the following salts will give a basic solution when dissolved in water? Circle your choice.

          $CaCl_2$, NH_4Cl, $NaClO_4$, Na_2CO_3, KI, none of these

          (2 points)   Write an equation for the reaction that occurs when the salt dissolves in water and makes the solution basic, or state why none do.

     c)   *(2 points)*   Which one of the following salts will give an acidic solution when dissolved in water? Circle your choice.

          $Ca_3(PO_4)_2$, NaBr, $FeCl_3$, NaF, KNO_2, none of these

          (2 points)   Write an equation for the reaction that occurs when the salt dissolves in water and makes the solution acidic, or state why none do.

3. (a) (8 points) What is the pH of a buffer solution prepared from adding 60.0 mL of 0.36 M ammonium chloride (NH_4Cl) solution to 50.0 mL of 0.54 M ammonia (NH_3) solution? (K_b for NH_3 is 1.8×10^{-5}).

   (b) (13 points) What is the final pH after 10.0 mL of 0.200 M NaOH solution is added to a 50.0 mL solution of 0.400 M acetic acid (CH_3COOH)? K_a for acetic acid is 1.8×10^{-5}.

   (c) (3 points) You don't have to add acid or base to a solution to change the pH, you can instead dilute the solution. What is the new pH if 100 mL of a solution of HCl with pH = 0.52 is diluted by addition of 200 mL of pure water?

4. (5 points) Calculate the solubility of the salt M_3X_4 (containing M^{4+} and X^{3-} ions) if the K_{sp} = 4.2×10^{-8}