Problem 1) $K_a = \frac{[H^+][C_6H_5COO^-]}{[C_6H_5COOH]}$

1. Make a RICE table for a weak acid like the one in the lecture slides for a weak acid
2. Assume $x \ll 0.180$ M
3. $[H^+] = [C_6H_5COO^-] = x$
4. Solve for x
5. Calculate pH from $[H^+]$

Problem 2) $K_a = \frac{[H^+][C_6H_5COO^-]}{[C_6H_5COOH]}$

1. Calculate moles of C_6H_5COOH
2. Calculate moles of $C_6H_5COO^-$
3.* Divide by the total volume to get new concentrations of C_6H_5COOH and $C_6H_5COO^-$
4. Solve for $[H^+]$ using the equilibrium expression
5. Calculate pH from $[H^+]$

Problem 3) $K_a = \frac{[H^+][ClO^-]}{[HClO]}$

1. $[H+] = [ClO^-] = 10^{-pH}$
2. Solve for [HClO]

Problem 4) $K_a = \frac{[H^+][CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$

1. Calculate moles of CH_3CH_2COOH
2. Calculate moles of $CH_3CH_2COO^-$
3.* Divide by the total volume to get new concentrations of CH_3CH_2COOH and $CH_3CH_2COO^-$
4. $[H+] = 10^{-pH}$
5. Solve for K_a

Problem 5) $K_a = \frac{[H^+][CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$

1. You already know moles of CH_3CH_2COOH from problem 4.
2. You also know moles of $CH_3CH_2COO^-$ from problem 4.
3. Calculate moles of NaOH added.
4. New moles of acid = initial moles of acid – moles of NaOH
5. New moles of base = initial moles of base + moles of NaOH
6.* Calculate new concentrations of CH_3CH_2COOH and $CH_3CH_2COO^-$ using new moles and total volume
7. Plug these into the equilibrium expression to calculate $[H^+]$
8. Calculate pH.

Lab Report Part 3: The first table (on page 80) is like Post-lab problem 3, but you are solving for K_a instead of [HA]. The second and third tables (on page 81) are just like Post-lab problem 4.

Lab Report Part 4: In the unbuffered solution, you do a dilution problem (3 mL to 38 mL) to calculate the new $[H^+]$ or $[OH^-]$, and then calculate pH. When HCl or NaOH is added to the buffered solution, the calculations are like Post-lab problem 5.

* - You can actually skip all of the starred steps and just use the number of moles of HA and A^- in the equilibrium expression instead of calculating the new concentrations. HA and A^- are in the same volume, so the volume cancels out. An equally valid form of the equilibrium expression is

$$K_a = \frac{[H^+] \times \text{moles of } A^-}{\text{moles of HA}}$$